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THESIS

**EMBEDDED EFFICIENCY: A SOCIAL NETWORKS
APPROACH TO POPULAR SUPPORT AND DARK
NETWORK STRUCTURE**

by

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March 2016

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ABSTRACT

This thesis poses the question, What is the nature of the relationships between social embeddedness, structural efficiency, and organizational behavior within dark networks? The objectives of this thesis are twofold. The primary objective is to illuminate the interaction between embeddedness, structure, and activity within dark networks, the aim being to study if changes in embeddedness manifest in observable fluctuations in a network's topography or behavior. The secondary objective is to evaluate the results of a novel, permutation-based methodology. Throughout, this thesis combines qualitative elements of social movement theory and social network analysis with quantitative statistical techniques to provide a mixed-method examination of three empirical dark network case studies (the Provisional Irish Republican Army, the Noordin Top Terrorist Network, and a Southeast Asian Foreign Fighter Facilitation network). The results of both the qualitative and quantitative methods are synthesized to highlight the strengths and limitations associated with each approach. This thesis reveals that, although embeddedness may contribute to rapid mobilization or organizational security, exogenous factors such as network shocks and endogenous variations in core membership may preclude such advantages from influencing internal network structure. Finally, this thesis recommends potential intelligence applications and areas for future social network research.

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LIST OF ACRONYMS AND ABBREVIATIONS

AQSEA	Al Qaeda in Southeast Asia
AQI	Al Qaeda in Iraq
ASG	Abu Sayyaf Group
BIFF	Bangsamoro Freedom Fighters
DDII	Indonesian Islamic Propagation Council (Dewan Dakwah Islamiyah Indonesia)
DI	Darul Islam
E-I	External-internal
FAKSI	Forum Anak Kost Se-Indonesia
FFF	Foreign fighter facilitation
HASI	Hilal Ahmar Society Indonesia
ICG	International Crisis Group
ICPVTR	International Center for Political Violence and Terrorism Research
IED	Improvised Explosive Device
IIRO	International Islamic Relief Organization
IRA	Irish Republican Army (Old)
ISCGP	Islamic Studies Call and Guidance of the Philippines
ISIL	Islamic State of Iraq and the Levant
IWM	Islamic Worldwide Mission
JAS	Jemaah Ansharus Syariah
JAT	Jemaah Ansharut Tauhid
JI	Jemaah Islamiyah
JMBPMS	JMB Personnel Management Services
KMM	Kumpulan Mujahidin Malaysia
KOMPAK	Komite Aksi Penanggulangan Akibat Krisis or “the Crisis Management/Prevention Committee”
MAK	Maktab al Khidamat lil-Mujaheddin al-Arab
MILF	Moro Islamic Liberation Front
MNLF	Moro National Liberation Front
NORAIID	Irish Northern Aid Committee

PAS	Organization of Muslim Scholars of Malaysia Pan-Malaysian Islamic Party
PIRA	Provisional Irish Republican Army
SMT	Social Movement Theory
SNA	Social Network Analysis
SNCD	Social Network Change Detection
SVBIED	Suicide Vehicle Born Improvised Explosive Device
UOB	United Overseas Bangsamoro
WKR	Wae Ka Rae (WKR)

I. INTRODUCTION

For an insurgency, a network is not just a description of who is in the insurgent organization; it is a picture of the population, how it is put together and how members interact with one another. For example, a tribal society already has affiliated social, economic, and military networks easily adapted to warfighting. The ways in which insurgents work within a tribal network is an expression of inherent cultural and social customs.

—Department of the Army¹

Terrorist and insurgent networks present a continuing threat to the security of the United States of America and its allies. In spite of ongoing intervention attempts, militant groups continue to grow and operate with varying levels of efficiency across the globe. Much of the research within the field of social network analysis (SNA) has focused on the internal constitution (topographical structure and membership) of *dark networks*.² However, limited research has been conducted on how external ties affect internal dark network dynamics. Moreover, in instances where authors address both network structure and external ties, they have typically approached these features as separate elements.³

Most researchers have used topographic network measures such as centralization and size as indicators of, and contributors to, efficiency.⁴ In some cases, organizational effectiveness and resilience is framed as dependent on these factors.⁵ These approaches frame dark network success or failure as primarily being internally determined, thereby downplaying the recognizable role played by external environmental factors.

¹ Department of the Army, *Insurgencies and Countering Insurgencies* (FM 3–24) (Washington, DC, June 2014), 4–18.

² Within this thesis, the terms “dark” and “bright” are used within the context established by Milward and Raab in “Dark networks as problems,” (2003) where dark refers to illegal and, covert and bright refers to legal and overt. Throughout this report these terms are used to describe characteristics of both groups and individuals.

³ Carlo Morselli, *Inside Criminal Networks* (New York: Springer, 2009), Chapter IV and Chapter V.

⁴ Walter Enders, and Paan Jindapon. “Network externalities and the structure of terror networks,” *Journal of Conflict Resolution* 1, no. 19 (2009), doi:10.1177/0022002709355439; Brafman, Ori, and Rod A. Beckstrom. *The Starfish and the Spider* (New York: Portfolio/Penguin Group, 2006).

⁵ Brafman, Ori, and Rod A. Beckstrom. *The Starfish and the Spider*.

Specifically, these approaches do not adequately address potential implications of a network's external ties to the surrounding society.

U.S. Army doctrine acknowledges the propensity for insurgent networks to be highly embedded within host societies. The Army's counterinsurgency field manual goes as far as describing "networked insurgencies" as adding "to the complexity of an area of operations because they are not acting as a unified force and because of their complex set of connections to the rest of society and each other."⁶ However, even this document does not prescribe methodologies for measuring embeddedness or for accessing and mitigating embeddedness's potential effects.

This thesis combines descriptive case study analyses of individuals and organizations with quantitative SNA to advance a longitudinal study of three separate dark networks. The networks surveyed in this thesis are the Noordin Top terrorist network that operated in Indonesia between 2000 and 2010, elements of the Southeast Asian Foreign Fighter Facilitation (FFF) network that operated between 1980 and 2015, and the Provisional Irish Republican Army (PIRA) that operated in Ireland between 1969 and 1998. This thesis's primary focus is the effect that ties between militant networks and other existing social entities have on network structure.

A. PURPOSE AND SCOPE

This thesis proceeds along two axes of inquiry, the first is research based and the second is methodological. The first axis answers the question: what is the nature of the relationship between social embeddedness, organizational behavior, and structural efficiency within dark networks? In answering the research question, this thesis examines linkages between dark networks and society, illuminating the roles of bright entities and associational networks within contested covert organizations. Along the second axis, the authors of this thesis, developed a permutation-based algorithm which attempts to normalize empirical statistical results, by comparing them to observations of randomized

⁶ Department of the Army, *Insurgencies and Countering Insurgencies (FM 3-24)* (Washington, DC, June 2014), 4-18.

simulated networks. The innovative methodology introduced, adds to the objectivity and analytical rigor of the traditional statistical and SNA methods used.

Along both axes, this thesis seeks to examine whether or not changes in the social embeddedness of dark networks manifests in observable fluctuations, in organizational structure or behavior (such as the number of attacks a network conducts). This thesis hypothesizes that increased embeddedness in bright networks has a positive effect on measures of organizational efficiency, including centralization, density, and average degree centrality. In addition, this thesis compares the results provided by qualitative and quantitative methods in order to reveal limitations associated with each approach. The resulting observations provide insights which may be useful to analysts and planners attempting to ascertain the resilience of existing and emergent dark networks. They may also provide intelligence professionals with focus areas for data collection and analysis.

Conceptually, this thesis uses a multidisciplinary approach that merges theories and methodologies from SNA, social movement theory (SMT), multiplex network mapping, and of social embeddedness. Methodologically, it employs longitudinal analyses of the growth and development of three dark networks in an attempt to observe instances in which embeddedness may have facilitated structural efficiency or influenced network activities.

For the purposes of this thesis, social embeddedness is defined as ties between a dark network and bright entities within the surrounding society. Dark network efficiency is inferred by measuring centralization, density, and average degree centrality.⁷ These metrics were selected based on evidence that network density and centralization within dark networks are correlated to organizational efficiency and on the assumption that there is an inverse relationship between these measures and operational security.

By analyzing topographic network dynamics over time, this thesis determines that embedding linkages play varied albeit significant roles in influencing dark network efficiency and structure. In the course of analysis this research also illuminates sources of

⁷ Detailed descriptions and equations for the network measures used within this thesis are provided in Chapter II of this thesis.

dark network resiliency. Analysis within the following chapters layers quantitative and qualitative SNA techniques. Quantitative methods focus on changes in topographic measures of dark network structure. Qualitative analysis explores the micro-level relationships and processes at work within three empirical datasets using descriptive case studies social network graphs and models of insurgent-population touch points.

B. RATIONALE

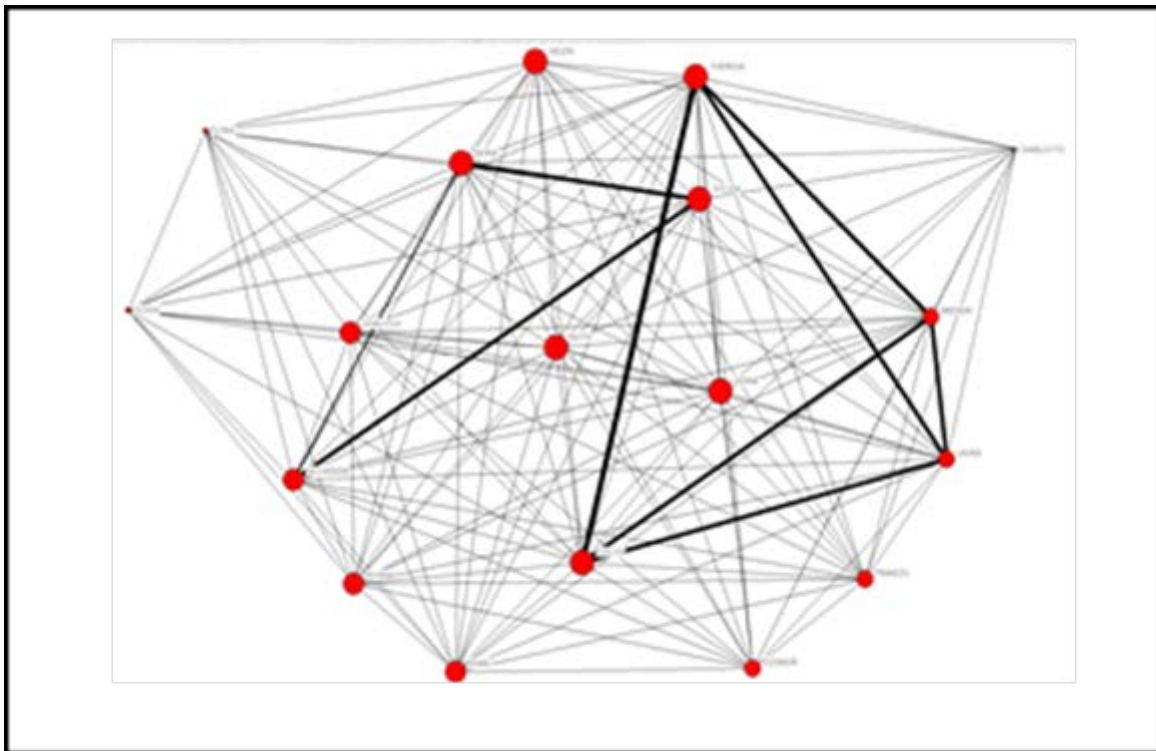
Dark networks are often highly embedded, maintaining ties to bright organizations and individuals within the societies in which they operate. These ties may be used to leverage both resources and legitimacy. Failure to fully understand the nature of the relationship between social embeddedness and militant resiliency is likely to have a negative impact on a security force's capability to combat such networks effectively. Different dark networks enjoy varying levels of support, cooperation, and resources from their surrounding environments. This support would seem to have some effect on the efficiency, resilience, and structure of these networks as well as their necessary levels of covertness. At present, the precise nature of this effect remains unknown. Everton and Cunningham point out that centralization and efficiency within dark networks are positively correlated, whereas centralization and security are frequently negatively correlated.⁸ However, dark networks that enjoy a greater degree of popular support (embeddedness) may be able to increase their centralization without sacrificing their security requirements. Thus, such organizations might be expected to operate with relatively higher degrees of both efficiency and resilience.

Contemporary SNA research methodologies for evaluating dark networks focus heavily on internal elements of network structure, typically using network boundary conditions that preclude developing a picture of the network in the context of its surrounding social environment. These methodologies measure dark network topography independently from bright network entities, as depicted in Figure 1. Alternatively, those researchers such as Morselli who have included links to bright actors/networks as part of

⁸ Sean F. Everton, and Dan Cunningham. "Terrorist network adaptation to a changing environment," in *Crime and Networks*, ed. Carlo Morselli (London, UK: Routledge 2013), 287–308.

their analysis have done so without testing the longitudinal effects of these connections on the actual structure of the corresponding dark networks.⁹ This thesis expands the understanding of the relationship between dark networks and their embeddedness by focusing on the number and type of external ties to *bright* and *shady* entities.¹⁰ This evaluation model is depicted in Figure 2.

Figure 1. Example of Internally Focused SNA Network Graph



This graph depicts prevailing social network analysis methodology: internally focused, emphasis on network structure and leadership “dark” nodes.

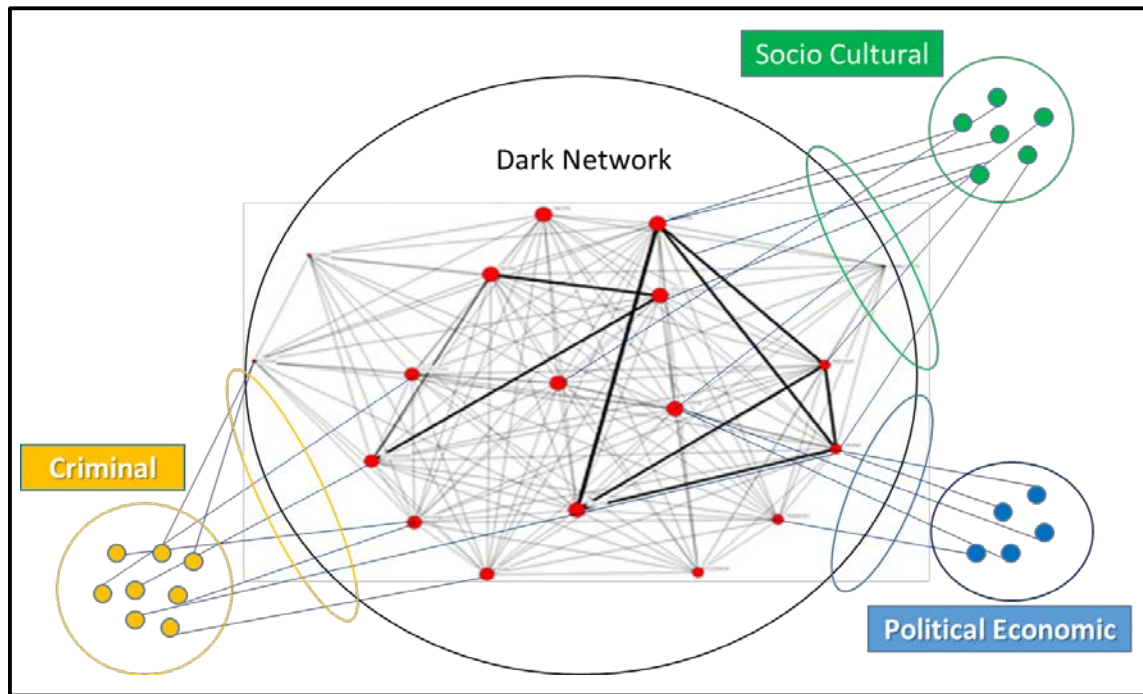
The Noordin Top terrorist network, Southeast Asian FFF networks, and the Provincial Irish Republican Army (PIRA) are examples of resilient dark networks that have achieved increased freedom of movement in conjunction with localized popular support. Case selection is outlined in further detail in Chapter III. This thesis attempts to

⁹ Carlo Morselli, *Inside Criminal Networks* (2009), Chapter 5.

¹⁰ For the purpose of this thesis shady entities refer to individuals whose actions and affiliation do not meet the threshold for categorization as member of either a dark or bright network.

shed light on if this freedom of movement can be observed through changes in network centralization and if these changes in internal structure correlate with changes in the number and type of external ties (embeddedness).

Figure 2. Example of Embeddedness-Focused SNA Network Graph



Conceptual network graph depicting embeddedness focused methodology: focuses on the number and type of external ties to “bright” and “shady” entities.

C. LIMITATIONS

This thesis presents a networks approach to understanding the dynamic relationship between dark organizations and their surrounding society. Although the tools and methods applied within this thesis are well established, they are limited by the availability of data and to the analytical constraints common to the methodologies employed. This thesis acknowledges the complex nature of dark networks and that there are likely a significant number of intervening considerations that affect organizational efficiency and behavior within covert groups.

Although efforts have been made to ensure that the data used throughout this report accurately reflect network membership and linkages, it is not possible to

independently validate the entirety of the networks depicted within this thesis. As such, all networks depicted should be assumed to be incomplete samples of the larger representative networks. This limitation is not unique to this analysis and is consistent with limitations of other similar efforts to depict relationships within intentionally covert organizations. In addition, it is necessary to acknowledge that centralization and density are not necessarily ideal indicators of efficiency. Social science scholars such as Everton have argued that optimal levels of centralization and density are mutually dependent and subject to a variety of environmental and organizational factors.¹¹ Milward and Raab, and others have pointed out that increased centralization and density may also increase security risks and operational tradeoffs.¹² However, these considerations exceed the scope of the analysis and are not specifically addressed within this thesis. This thesis does attempt to mitigate potential issues arising from both of the above limitations by using geographically and temporally diverse network samples as case studies. This sample variation should at least partially moderate the effect of deviations in structure resultant from incomplete data or deviations in security considerations.

D. THESIS OUTLINE

The research within this thesis is divided into seven chapters. The first three chapters provide a theoretical and methodological background for the thesis. Chapter I has provided a substantive research summary of the research. Chapter II offers a foundational overview of the key theoretical concepts, and literature used throughout the course of the research including SNA, SMT, multiplex network mapping, and embeddedness. Chapter III provides a detailed discussion of the data and methods used in aggregating and analyzing the information within this thesis.

Chapter IV outlines the origins and evolution of each network case study, thus providing the historical context necessary for subsequent analysis. Chapter V provides a correlational analysis of the relationship between External-Internal (E-I) index, network

¹¹ Sean F. Everton, *Disrupting Dark Networks*, (New York: Cambridge University Press, 2012).

¹² Brinton H. Milward, Jörg Raab, "Dark Networks as Organizational Problems: Elements of a Theory," *International Public Management Journal* 9, no.3 (2006): 333–360.

topography, and network behavior for each of the three network cases throughout their lifespans. Correlations are evaluated both individually and in aggregate and followed by a summarized discussion of the findings. Chapter VI provides a set of descriptive case study analyses. These analyses draw from historic reports on individual network members and their interactions with surrounding societies to generate sociograms and narrative examples of embedding processes. This work is be nested within the theoretic constructs introduced in Chapter II by emphasizing the roles of microstructures and relational ties in dark network mobilization.

Chapter VII compares the results of the chapters V and VI and provides a discussion of the similarities and differences between the results of the two complementary research methods. Additionally, Chapter VII describes the implications of the aforementioned findings within the context of dark network disruption strategies, intelligence collection and analysis, and future dark network research.

II. THEORETICAL FRAMEWORK

Doug McAdam suggests that “quantitative analysis can be used, as in the study of social movements, to uncover certain recurrent empirical relationships, that can then be interrogated more fully using systematic qualitative methods.”¹³ It is through a combination of these two complementary methods that this thesis goes about applying social network analysis SNA to the study of dark networks. This chapter is divided into two sections that lay out the theories upon which the remainder of the thesis is built. The first section introduces the theoretical paradigms that serve to inform the overall rationale of the research and which provide the basis of both the descriptive and explanatory depth within Chapter IV. The second section provides an overview of the measures used prominently within Chapter V. The literature surveyed in this chapter provides an introductory overview of the primary methods from each discipline that were applied in the course of this research.

The foundation of the research is built using fundamental principles from SNA enabled through multiplex network mapping, and social network change detection. These principals are augmented using conceptual and theoretical elements from research on SMT and embeddedness to build a novel methodology for analyzing dark networks.

A. QUANTITATIVE LITERATURE

SNA is an analytical method that uses relational ties between like entities (sometimes referred to as “nodes” or “actors”) in conjunction with graph theory to generate visual and mathematical representations of social networks. These representations may be used to inform expectations of individual and network behavior.¹⁴ Sean Everton describes SNA as “a collection of theories and methods that assumes that the behavior of actors (whether individuals, groups, or organizations) is profoundly

¹³ Doug McAdam, “Beyond Structural Analysis” in *Social Movements and Networks: Relational Approaches to Collective Action*, eds. Mario Diani and Doug McAdam (New York: Oxford University Press, 2003).

¹⁴ Sean F. Everton, *Disrupting Dark Networks*, Chapter 1.

affected by their ties to others and the networks in which they are embedded.”¹⁵ This thesis applies SNA methodologies to evaluate the ties which link these dark networks and their surrounding societies and the effect those ties have on the internal network structure of militant organizations. The SNA metrics used to evaluate this relationship are the E-I index, network centralization, and network density (average degree centrality).¹⁶

1. Multiplex Network Mapping

Human social networks typically comprise multiple interdependent relationships, kinship, trust, and communication. Multiplex network mapping is a process within SNA for representing social network ties across multiple relation types in order to inform a more robust understanding of network structure and behavior. Roger Gould’s analysis of network mobilization in the Paris commune provides an example of the value of multiplex mapping as a means of understanding network mobilization processes.¹⁷ In his study, Gould evaluated the role of formal and informal networks in contributing towards neighborhood solidarity. He found that preexisting social ties affected the organizational behavior and cohesion of newly formed discrete networks. He also found that different networks were interrelated to one another and contributed jointly to affecting mobilization dynamics, thus validating the argument that the whole network must be considered in order to understand the overlapping patterns.¹⁸ This thesis explores the significance and implications of multiplex network ties within both the quantitative and qualitative chapters in order to examine whether or not certain types of external relationships are more predictive than others in informing structural change within networks.

¹⁵ Sean F. Everton, *Disrupting Dark Networks*, 6.

¹⁶ Due to the inherent limitations of the density equation in providing objective measures for comparing networks of differing size, average degree centrality will be used as a stand-in metric for density to represent the provincial-cosmopolitan dimension of the networks. These limitations, as well as a description of provincial cosmopolitan aspects of networks, are discussed in detail later in this chapter.

¹⁷ Roger V. Gould, “Multiple Networks and Mobilization in the Paris Commune, 1871,” 716-729.

¹⁸ Ibid., 727.

2. Social Network Topography and Change Detection

Within the context of SNA, network topography refers to the macro level measurements that characterize the structure of the network. The most basic topographic measure is size, which simply refers to the number of nodes within a given network. Other commonly used measurements like centralization and density attempt to characterize the network in terms of how the nodes within a network connect to one another. These measures and others are defined in further detail in subsequent sections within this chapter. Social network change detection (SNCD) is essentially the process of analyzing changes in network topography over time in order to identify potentially significant changes within the network that may be indicative of important events.¹⁹ Multiple scholars have demonstrated the potential value of this methodology in combatting terrorist organizations.²⁰ This thesis employs SNCD as a means to conduct a statistical analysis of the relationship between the topographic measures of E-I Index, network centralization, network density and average degree centrality.

3. E-I Index

The E-I index developed by David Krackhardt describes the structural connectedness of a network by calculating the ratio of ties within a network to those outside of the network. Within this thesis, the E-I index is used to measure the degree in which network linkages connect covert elements of dark networks with their surrounding societies.²¹ Mathematically the E-I index of a network is expressed as:

$$E-I = (EL - IL) / (EL + IL)$$

19 Sean F. Everton & Dan Cunningham “Detecting Significant Changes in Dark Networks,” *Behavioral Sciences of Terrorism and Political Aggression* 5, no.2 (2013): 94–114.

20 Ibid. McCulloh, Ian, and Kathleen M. Carley. “Detecting Change in Longitudinal Social Networks.” *Military Academy West Point NY Network Science Center (NSC)*, 2011. Sean F. Everton, and Dan Cunningham. “Dark Network Resilience in a Hostile Environment: Optimizing Centralization and Density.” *Criminology, Criminal Justice, Law and Society* 16, no. 1 (2015): 1–20.

21 A detailed description of E-I index coding methodologies used within this thesis is provided in the methods chapter of this thesis (Chapter III).

where “EI is the E-I index of the organization, EL is the number of external links, across divisions, and IL is the number of internal links, which does not cross divisions.”²² This formula is useful in establishing the relative distribution of external and internal ties within a network. The E-I index can be calculated and applied at the network, group, or individual node level. This thesis primarily uses group E-I index as a measure of organizational embeddedness of the dark network segment. Group level embeddedness was selected in order to prevent high or low levels bright segment intra connectivity from artificially skewing E-I values.

There are some limitations to using E-I index as a means of comparing the embeddedness of network datasets of varying size as large organizations invariably receive lower E-I ratings than small organizations with equivalent ties. As Robert Hanneman and Mark Riddle note, “the relative sizes of sub-populations have dramatic consequences for the degree of internal and external contacts, even when individuals may choose contacts at random.”²³ For the purpose of this thesis, these aforementioned limitations are partially mitigated by the fact that all three of the networks being evaluated are of similar size and that within each network the size of the potential bright subpopulation is largely unrestricted. Additionally, this thesis attempts to mitigate this deficit by combining the E-I index with a qualitative analysis of external ties informed by principals of SMT.

4. Centralization

Network centralization is a topographic measure that describes the hierarchical structure of a network. Centralized networks manifest in instances where node linkages are distributed in a highly stratified fashion and in which a small number of nodes are significantly more connected than the least connected nodes. Such networks are described as being “scale free.” Albert Barabási and Eric Boneabeau describe scale free networks as those in which a few nodes have a large number of connections. Scale free networks

²² David, Krackhardt, “Graph Theoretical Dimensions of Informal Organizations.” *Computational Organization Theory* 89, no. 112 (1994): 129.

²³ Hanneman, Robert A., and Mark Riddle. *Introduction to social network methods*, (Riverside, CA: University of California Riverside, 2005): 96.

differ from fully random networks, which are decentralized with nodal connections which follow a normal distribution.²⁴ Wasserman, Stanley and Faust give the expression for centralization as:

$$C = \frac{\sum [C_{\max} - C(n_i)]}{\max \sum [C_{\max} - C(n_i)]}$$

where C_{\max} equals the largest centrality score for all actors and $C(n_i)$ is the centrality score for actor n_i , and $\max \sum [C_{\max} - C(n_i)]$ is the theoretical maximum possible sum of differences in actor centrality. In other words, network centralization is the ratio of the actual sum of differences in actor centrality over the theoretical maximum, yielding (like density) a score somewhere between 0.0 and 1.0.²⁵

This thesis uses changes in dark network centralization to attempt to track a network's tendency towards efficiency over robustness over time. Generally speaking, centralization improves dark network efficiency²⁶ but may also result in reduced robustness/resilience. Mark Sageman describes network robustness in terms of a network's ability to continue to operate after losing individual members.²⁷ He states that where hierarchical networks are vulnerable to decapitation,²⁸ distributed small-world network structures are relatively resilient in the face of random node removal but are susceptible to coordinated simultaneous attacks against hubs.²⁹ Sageman also writes that hubs (a dominant feature of centralized networks) are vulnerable to discovery and

²⁴ Albert-Laszlo Barabási and Eric Bonabeau, "Scale Free Networks" *Scientific American*, 288, no. 5 (May 2003): 53.

²⁵ Wasserman, Stanley, and Katherine Faust. *Social Network Analysis: Methods and applications*, (Cambridge, UK: Cambridge University Press, 1994), Chapter 5.

²⁶ Everton and Cunningham have found evidence to support the argument that dark networks may increase their centralization prior to execution of attacks (Everton, Sean F., and Dan Cunningham. "Dark Network Resilience in a Hostile Environment: Optimizing Centralization and Density," 1–20.

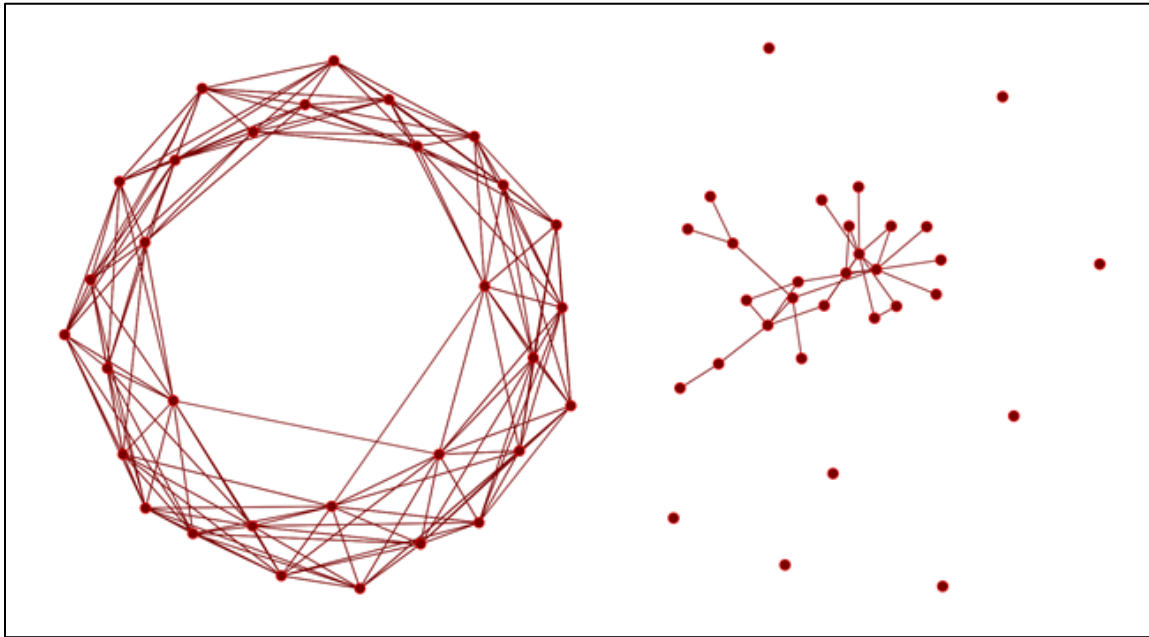
²⁷ Marc Sageman, *Understanding Terror Networks*, (Philadelphia: University of Pennsylvania Press, 2009), 140–141.

²⁸ Decapitation described here refers to network disruption through the targeted removal of leadership nodes.

²⁹ Network hubs are highly connected nodes within a network. See Marc Sageman, *Understanding Terror Networks*, 140–141.

recommends them as targets for intelligence collection and law enforcement disruption efforts.³⁰ Figure 3 depicts examples of idealized small world and scale free networks.

Figure 3. Example of Small World and Scale-Free Network Graphs



Example graphs depicting “small world” (left) and “scale-free” (right) networks.

5. Density and Average Degree

Network density and average degree centrality measure the provincial-cosmopolitan dimension of social networks. Conceptually, provincial networks are dense networks comprised primarily of strong ties whereas cosmopolitan networks are comprised of sparse or weak ties.³¹ Network density describes the number of actual ties within a network compared to the total number of possible ties. Like small world networks, networks with dense structures and those with high average degree centrality (described in the following paragraphs) are relatively resistant to random failure and allow for expedient communication. It is for these reasons that this thesis uses these two measures as proxies for describing efficiency.

³⁰ Marc Sageman, *Understanding Terror Networks*, 140–141.

³¹ Sean F. Everton, “Network Topography, Key Players and Terrorist Networks,” *Connections* 1, no. 32 (June 2012): 12–19.

In an undirected network density is expressed as:

$$d = \frac{t}{\frac{n*(n-1)}{2}}$$

where t equals the number of ties within a network and n equals the number of nodes within the same network. This metric has a possible value ranging from 0.0 to 1.0. Everton points out that network density is a contributing factor towards network efficiency.³²

The density metric presents limitations similar to the E-I index when comparing networks of different sizes. In this case, as networks increase in size linearly the number of possible links in the network increases exponentially. Because the number of actual network ties does not typically increase exponentially with the addition of new members and because network members will themselves reach some upward limit on their number of practical ties the density metric disproportionately punishes large networks in its calculation of provinciality. To overcome this limitation this thesis estimates density using average degree centrality, which is calculated as the average number of ties of a node within a given network:

$$\overline{D} = t / n$$

where t equals the total number of ties within a network and n equals the number of nodes within the same network. Unlike density, average degree centrality scores are not sensitive to network size and are frequently used as a substitute measurement for density when comparing networks of different dimensions.

Although maintaining a dark network with dense ties has some advantages, it also generates a number of vulnerabilities. While dense networks are likely to be resilient to attack they are also more vulnerable to detection and to exploitation through intelligence collection or infiltration. The arrest or capture of individual network members is less likely to lead to immediate network collapse but is more likely to lead to the apprehending of remaining network participants. As a result of this inherent security tradeoff, it follows that provincial networks require countervailing environmental or

³² Sean F. Everton, *Disrupting Dark Networks*, 2012.

operational incentives in order to make increased density an attractive strategy. Everton and others have described the delicate balance between efficiency and security in detail.³³

B. QUALITATIVE LITERATURE

Social network scholars tend to employ one of three models for approaching the study of human interaction. These models are structural determinism, instrumentalism, and constructionism. According to Mustafa Emirbayer and Jeff Goodwin structural determinism “features a succession of network ‘snapshots’ of social structure, while negating altogether the potential causal significance of symbolic and discursive formations and offering few insights into the concrete historical mechanisms leading from one such network configuration to another.”³⁴ Structural determinism downplays the role played by human agency and disregards the impact of individual actors and evolving cultural considerations in shaping social processes and actions.³⁵

Structural instrumentalism addresses the importance of “social action” without particular focus on an actor’s identity.³⁶ This approach ascribes actors’ decisions to “rational choice instrumental action and utility maximization.”³⁷ Instrumentalism offers an improvement over the structuralist approach in terms of acknowledging the role of agency but continues to overlook the full range of potential variables that influence individual behavior.

Structural constructionism builds upon instrumentalism by attempting to take into consideration both structural considerations as well as rational choice by acknowledging “that [an] actor’s goals and aspirations might very well be complex, multivalent, and

33 Sean F. Everton and Dan Cunningham, “Dark Network Resilience in a Hostile Environment: Optimizing Centralization and Density,” *Criminology, Criminal Justice Law, & Society*, 16, no.1 (2015), 1–20; Carlo Morselli, *Inside Criminal Networks*. (New York: Springer, 2009): Chapter 4.

34 Mustafa Emirbayer and Jeff Goodwin, “Network Analysis, Culture and the Problem of Agency,” *American Journal of Sociology* Vol. 99, No. 6 (May 1994): 1436.

35 Ibid

36 Ibid.

37 Sean F. Everton, *Disrupting Dark Networks*, (2012), 29.

historically determined.”³⁸ The structural constructionist model expands the scope of agency as introduced by instrumentalism by taking into account factors like social norms and culture, or in the case of this thesis, embeddedness.

Analysis within the following chapters applies the constructionist model by augmenting the structurally based outputs from quantitative SNA with descriptions of actor attributes and behavior. To this end this thesis operationalizes conceptual elements from Gould’s work as described in Section one,³⁹ as well as the work of Granovetter on embeddedness⁴⁰ and the work of McAdam⁴¹ (and others) on recruitment and mobilization. It layers quantitative data pertaining to preexisting multiplex relationships between dark and bright networks over topographic metrics of dark network structure and individual node level case studies to aid in understanding the intervening relationships within each of the three datasets.

1. SMT: Microstructures and Relational Ties in Mobilization

SMT is a body of knowledge that seeks to address the underlying factors of mobilization in social movements. Modern SMT as pioneered by Doug McAdam presents a multilevel perspective on the role of network structure and resources. Within the context of this thesis, SMT provides depth toward understanding the reasons and ways networks shift that cannot adequately be explained through mathematical analysis alone.

Social movement theorists have repeatedly demonstrated the importance of microstructures in social mobilization. Doug McAdam’s study of “freedom summer” participants found that the strongest predictors of participation in high-risk activism were the number and strength of ties to other applicants. Applicants with more ties or with

³⁸ Mustafa Emirbayer and Jeff Goodwin, “Network Analysis, Culture and the Problem of Agency,” 1436.

³⁹ Roger V. Gould, “Multiple Networks and Mobilization in the Paris Commune, 1871,” *American Sociological Review* 56, No. 6 (December 1991): 716–729.

⁴⁰ Mark Granovetter, “Economic Action and Social Structure: The Problem of Embeddedness,” *American Journal of Sociology* 91, no. 3 (November 1985): 481–510.

⁴¹ Doug McAdam, “High-Risk Activism: The Case of Freedom Summer,” *American Journal of Sociology* 92, no. 1 (July, 1986): 64–90.

strong ties to other participating applicants were more likely to participate themselves. McAdam also found that a second important predictor was the number and type of pre-existing ties to organizations. Individuals were found to be more susceptible to recruitment to activism, the more organizations they belonged to. Ties to activist organizations provided an even stronger predictor of recruitability.⁴² David Snow, Louis Zurcher, and Sheldon Ekland Olson's study on differential recruitment to social movements produced complementary findings.⁴³ Their results point to the importance of interpersonal and kinship ties between movement members and the surrounding social milieu in determining recruitment potential. Both findings are germane to understanding the dark network case studies surveyed within this thesis since all three networks incorporated elements from both high-risk activism and recruitment.

2. Embeddedness

Mark Granovetter popularized the concept of embeddedness as a sociological approach to understanding the effects of institutional relationships on economic action. He describes social embeddedness as "the extent to which economic action is embedded in structures of social relations, in modern industrial society."⁴⁴ Granovetter proposes that an organization's actions are both enabled and constrained by relationships⁴⁵ and that these relationships impact both institutional interests and behavior.⁴⁶ There are various ways in which a dark network can attempt to increase their embeddedness within a society. Prior to the Sunni awakening, Al Qaeda in Iraq (AQI) leveraged the embeddedness of associated tribal leaders to coopt the preexisting authority networks in

42 McAdam Doug, "High-Risk Activism: The Case of Freedom Summer."

43 David A. Snow., Louis A. Zurcher Jr., and Sheldon Ekland-Olson. "Social Networks and Social Movements: A Microstructural Approach to Differential Recruitment." *American Sociological Review* 45, no. 5 (1980): 787–801.

44 Mark Granovetter, "Economic Action and Social Structure: The Problem of Embeddedness," 481.

45 Embeddedness enables actions by reducing market objectivity normally associated with (in this case economic) interactions. Embeddedness constrains actions by reducing opportunism defined by Granovetter as "the rational pursuit by economic actors of their own advantage, with all means at their command, including guile and deceit." Mark Granovetter, *Economic Action and Social Structure: The Problem of Embeddedness*, 494.

46 Mark Granovetter, "Economic Action and Social Structure: The Problem of Embeddedness," 481–510.

order to embed their organization within Sunni society.⁴⁷ As the U.S. forces increased trust, financial, and political relationships with the Sunni tribesmen, embedded support to AQI diminished and switched to security forces.⁴⁸ Alexis Grynkeiwich provides an illustrative example of how “violent non-state groups” increase social embeddedness through manipulation of the social contract by providing social services within their host societies.⁴⁹ This thesis analyzes how dark network embeddedness enables movement toward increased structural efficiency and how it constrains violent activity.

47 John A. McCary, “The Anbar Awakening: an Alliance of Incentives,” *The Washington Quarterly* 32:1 (2009), 43–59, DOI: 10.1080/01636600802544905.

48 Ibid.

49 Alexis G. Grynkeiwich, “Welfare as Warfare: How Violent Non-state Groups Use Social Services to Attack the State,” *Studies in Conflict & Terrorism* 31, no. 4 (2008): 350–370.

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III. CASE SELECTION AND METHODOLOGY

This chapter provides an introduction to the empirical cases and methods used in chapters IV and V. This chapter is divided into three sections. The first describes the data coding and ontological categories used. The second introduces the three network case studies and describes the case selection criteria and content and the third details the thesis's research design.

This thesis used empirical case studies of dark networks drawn from a broad range of secondary sources to describe and investigate historically significant examples of Dark network behavior and development. The selected empirical cases included a Southeast Asian Foreign Fighter facilitation (FFF) network, the Noordin Top terrorist network, and the Provincial Irish Republican Army (PIRA). Cases were subjected to a mixed methods analysis incorporating elements of social network analysis (SNA) and SMT in order to thoroughly examine the effect of socially embedded relationships on dark network structure and behavior. Structural elements evaluated within this thesis include network density, average degree centrality, centralization, and the E-I index. Behavioral elements evaluated include violent attacks in the case of the Noordin and PIRA networks and network growth in the case of the Southeast Asian FFF network.

A. DATA CODING

Across all categories of linkages, bright links/nodes are only included as part of the analysis when there is also evidence that the relationship contributed in some way directly or indirectly to a dark network's ability to achieve its objectives. This boundary restriction ensures that the resultant analysis does not result in a collection of spurious tangential links.

Networks were mapped with actors categorized as bright, dark, or shady. This thesis defines entities in the same manner as Milward and Raab describe dark networks, understanding "dark" to refer to illegal or covert organizations or individuals.⁵⁰ Entities

⁵⁰ Brinton H. Milward, and Jörg Raab, "Dark Networks as Problems," *Journal of Public Administration Research and Theory* 13, no.4 (2003): 413–439.

are categorized as dark based on the criteria that the organization itself is illegal or outlawed within its area of operation, the majority of the organization's operations are dedicated towards facilitating illegal activity, and that the organization conducts the majority of its operations in a covert fashion.

Entities that meet all of these criteria are classified as dark. Those that do not meet any of the above criteria are classified as bright. Those that meet some but not all of the criteria are classified as "shady." In cases where the category of organization changes over time groups are classified based on the status during the interval of evaluation when practicable.

B. CASE SELECTION AND DATA DESCRIPTIONS

The dark networks case studies chosen for evaluation within this report were selected based on length of network existence, the presence of environmental contestedness⁵¹ and availability of data. All three networks have operated for ten or more years thus allowing for sufficient temporal variation to support a meaningful longitudinal analysis.⁵² Each of these networks has been deliberately contested throughout their existence by internal or external security forces; contestedness is important to consider as it tends to affect network structure and have been found to correlate with decreased network density and centralization.⁵³ The specific effects of contestedness are not considered due to the difficulty involved in consistently measuring for or normalizing contestation across the three datasets. Additionally, all three networks have sufficient relational data for observing linkages between dark network entities and the surrounding society to support an in depth SNA. This thesis selected the PIRA network in part to introduce some measure of geographic, ideological, and ethnic network diversity into the study.

⁵¹ Environmental contestedness will be defined as the degree to which a dark network's operational freedom is challenged by another organization (i.e., local or foreign governments, or competing networks).

⁵² This thesis focuses primarily on the analysis of persistent dark networks. Temporary ad-hoc networks formed specifically for executing individual attacks abroad were not considered as candidates for analysis. Such networks are likely to be isolated from the surrounding population and may have unique operational requirements and be less reliant on external support.

⁵³ Sean F. Everton, and Dan Cunningham. "Terrorist Network Adaptation to a Changing Environment," 287–308.

1. Southeast Asian FFF Network

The Southeast Asian FFF Network dataset is a one-mode network containing 281 nodes. This dataset includes 36 observation intervals. It encompasses the longest period of time spanning 36 years. This dataset is original to this research and was derived from multiple sources. Historic data was aggregated through the extraction and expansion of relational data from articles published by the International Crisis Group (ICG).⁵⁴ Additional background information and further relational data was drawn from the International Centre for Political Violence and Terrorism Research (ICPVTR) database, academic articles, books, and open source documents. Members coded as dark members included, any individual or group that directly fought in a foreign or domestic insurgency, or has been classified as a terrorist organization.

2. Noordin Top Terrorist Network

The Noordin Top Terrorist network dataset comprises 237 unique nodes. Longitudinally this dataset includes 121 observation periods spanning the 10 years in which the group was active. The Noordin Top dataset was compiled by Nancy Roberts, Sean Everton, and Daniel Cunningham. The dataset is based largely on two International Crisis Group Reports: “Terrorism in Indonesia: Noordin’s Networks” (International Crisis Group, 2006) and “Indonesia: Noordin Top’s Support Base” (International Crisis Group, 2009). Due to some geographical, temporal, and organizational overlap, the Noordin Top Terrorist network will share some structural and membership elements with the Southeast Asian FFF network. Dark members are individuals whose role within the network included bomb maker, bomber, fighter, leader, suicide bomber, or those whose logistical function involved the transportation of weapons.

⁵⁴ ICG articles used include- “Indonesia Backgrounder: How the Jemaah Islamiyah Terrorist network Operates,” *Asia Report* no 43, “Indonesia: Jemaah Islamiyah’s Publishing Industry,” *Asia Report* no. 147, “Indonesia: Jihadi Surprise in Aceh,” *Asia Report* no. 189, “How Indonesian Extremists Regroup,” *Asia Report* no. 228, “Indonesia: The Dark Side of Jama’ah Ansharut Tauhid (JAT),” *Asia Briefing* no. 107, “Indonesia: From Vigilantism to Terrorism in Cirebon” *Asia Briefing* no. 132.

3. PIRA Network

The PIRA dataset provides a dark network case study that is geographically, culturally, and ideologically distinct from the previous two networks. It encompasses nearly 30 years: 1970–1998. The data set comprises 1,113 unique nodes and recorded during six observation periods. This dataset does not include isolates and the identity of individual network members has been anonymized. The network includes four types of relationships between members: (1) those who committed an act together within the movement, (2) those who were friends prior to joining the movement, (3) blood relatives, and (4) those related by marriage. The data used in this analysis was originally collected, aggregated, and analyzed by Paul Gill, Jeongyoon Lee, Karl R. Rethemeyer, John Horgan, and Victor Asal at the International Center for the Study of Terrorism, Pennsylvania State University.⁵⁵ In this thesis, agents within the dataset are broken into groups based on their activities within the network. Dark members are any of those who participated in violent or illicit activities such as robbery, kidnapping, improvised explosive device (IED) construction, bombings, or shootings and assassinations. Bright members are individuals who have not been associated with any of the aforementioned violent activities.

C. RESEARCH DESIGN

This thesis applies complementary descriptive case study observations of individual network members and their interactions with surrounding societies and correlational analysis to examine the relationships between social embeddedness, dark network organizational behavior, and structural efficiency. Each analytical method is contained within its own chapter. The quantitative chapter evaluates if the hypothesized relationships between social embeddedness and structural efficiency are observable using topographic SNA measures. The qualitative chapter is primarily exploratory. Its purpose is to provide a depth to the results of the quantitative analysis by painting a robust picture of the intersecting roles of meta-network structure, exogenous influences and human agency, which cannot be fully captured through quantitative approaches alone.

⁵⁵ Ibid., 60.

1. Quantitative Methods

The foundation of the analysis in Chapter IV is based on longitudinal metric descriptions of network snapshots. Throughout this chapter, embeddedness is used as the independent variable and measures of network efficiency (density, centralization, average degree centrality) are used as separate dependent variables. Analysis measures variations within embeddedness, and centralization and average degree centrality for each network snapshot. These values are then used to calculate the covariance and coefficient of correlation between these two variable sets.

a. Measuring Embeddedness

Embeddedness of dark networks are be measured as a function of the number and quality of crosscutting domain ties connecting nodes within a given dark network to its host society. Relative embeddedness is assessed as high in instances where the surrounding society has a high number of ties to the network or where the network has a high number of ties to elements within society. Nodes are considered part of a dark network if they self-identify as members or if they are known to occupy leadership positions directly and perform operational tasks within the organization. All other affiliated nodes are measured as elements of the surrounding society.

Quantitatively, network embeddedness is inferred from E-I index values calculated based on links between entity categories. Internal (dark) network ties are characterized by links between nodes directly related to planning, executing, or supporting covert activity. In turn, links between internal network entities and external (bright and shady entities) are used in calculating values for external ties. External ties are characterized by facilitation linkages such as funding, promoting, or recruiting for illegal activity. All linkages between entities are coded based on type of embedded tie. Final analysis uses multivariate regression to examine the degree to which different types of social embeddedness have observable impacts on network structure.

b. Estimating Network Efficiency

Network efficiency for each time period snapshot is inferred from measurements of centralization and average degree centrality. Network observations with higher levels of centralization and interconnectedness are assessed to be relatively more efficient than those with lower levels. Calculations of these measures are derived using standard the SNA techniques described in Chapter II after first identifying and then removing external nodes. The removal of external nodes prior to calculating topographical metrics for efficiency reduces the autocorrelation between the observed variables and produces resultant values that more accurately reflect changes in the structure of dark segments of the network.

c. Estimating Statistical Significance

The statistical significance of the relationship between embeddedness and efficiency is estimated using a parametric model (Pearson's product-moment correlation).⁵⁶ In order to address potential concerns related to type one errors and autocorrelation between the evaluated topographic measures, case study correlations between E-I index and the dependent variables of centralization, density, and average degree centrality are compared to *p*-values, confidence intervals, and sample estimates from simulated permutations of the empirical network. The difference in the empirical results and those of the simulated networks provide indicators of the statistical significance of the relationships tested, independent of artifacts resultant from autocorrelation.

d. Network Permutations

In addition to traditional methods of statistical analysis introduced previously, this thesis introduces a novel quantitative methodology by augmenting empirical observations with simulated network data. Simulated networks used in in this thesis were generated using a set of purpose-built algorithms. In total, the algorithm read-in the empirical

⁵⁶ This model was selected based on the dominantly normal distribution of values observed in order to provide consistency among analyses. A minority of measures surveyed manifested with a multimodal or skewed distributions these exceptions are identified as they occur.

network data, sampled node labels, edges, and attributes (used to calculate E-I index) from all observation period within the empirically observed networks; these sample variables were then permuted 5,000 times each using the Monte Carlo Method. The end result is a set of 5,000 row arrays (one for each network observation). Each network array was then measured for E-I index, average degree, centralization and density. The use of simulated networks in this thesis offers a unique objective baseline from which to evaluate observations of the empirical data. This baseline attempts to allow for a more objective interpretation of the empirical network measures both independently and in terms of correlation with other measures.

2. Qualitative Methods

Chapter V uses descriptive vignettes and social network graphs to examine the development of individual mobilization, embedding processes, and bright network connections through the lens of social movement theory.⁵⁷ Conclusions from this section exploratory section are then nested with activity analysis, which evaluates fluctuations in different types of organizational behavior. Activity analysis of the Noordin Top and PIRA networks examines volume and variety of violent attacks conducted within the networks domestic area of operations. This analysis within this section serves to provide a supporting contextual background to the statistically driven quantitative chapter.

⁵⁷ Network graphs used within qualitative and quantitative chapters will be depicted using the “spring embedded” layout unless otherwise specified.

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IV. NETWORK BACKGROUNDS

This chapter provides descriptions of each of the three network cases: The Southeast Asian Foreign Fighter Facilitation (FFF) Network, the Noordin Top terrorist network, and the Provisional Irish Republican Army (PIRA). The objective of this chapter is to provide the necessary background on the origins and evolution of each network case study to allow for an understanding of the analysis in Chapter V and Chapter VI of this thesis. This chapter is divided into three sections, each focused on a single empirical network case.

1. Southeast Asian FFF Network

The Southeast Asian FFF Network is an informal covert network of individuals and organizations that have participated in the recruitment, training, funding and manning of jihadists organizations within Afghanistan, Iraq, Syria, and various countries within the Southeast Asian region. This network initially emerged in the 1980s in response to the Soviet occupation of Afghanistan, during which time it provided fighters in support of the Al Qaeda predecessor Maktab al Khidamat (MAK).⁵⁸ The Southeast Asian FFF network has since continued to provide support and training to jihadists both locally and abroad. The network has enjoyed support from a diverse array of entities including fundamentalist religious schools, political activist organizations, and terrorist organizations. Network membership spans the majority of Southeast Asia and is concentrated within Indonesia, Malaysia, and the Southern Philippines.

The presence of Islamic foreign fighters is not unique to jihadi movements or to Southeast Asia. It is however, a relatively modern development. Thomas Hegghammer,⁵⁹ defines a foreign fighter as “an agent who (1) has joined, and operates within the confines of, an insurgency, (2) lacks citizenship of the conflict state or kinship links to its

⁵⁸ Maktab al Khidamat was formed as a charity front to support bin Laden’s fight against the Soviet Union in Afghanistan. It had ties to the Pakistani government through its state security services and has been inactive since 1984 (Terrorism Resource Analysis Consortium, <http://www.trackingterrorism.org/group/maktab-al-khidamat-mak>).

⁵⁹ Thomas Hegghammer is the director of terrorism research, at the Norwegian Defense Research Establishment.

warring factions, (3) lacks affiliation to an official military organization, and (4) is unpaid.”⁶⁰ According to Hegghammer, foreign fighters first appeared in significant numbers in 1967 during the Arab Israeli War but did not become wide spread until the 1980s. The first major instance of Southeast Asian foreign fighters was during the Afghan Soviet war between 1978 and 1992. According to Hegghammer, this conflict drew foreign fighters from throughout the Arab world, as well as from Pakistan, Bangladesh, Indonesia, Philippines, the United States, and Europe. Although reports vary on the total number of Southeast Asian Mujahedeen that traveled to Afghanistan the total number of Southeast Asian fighters likely numbered over 1,000. Maria Ressa writes that Moro Islamic Liberation Front (MILF) founder Hashim Salamat provided over 600 foreign fighters to the MAK-led Afghan resistance in 1980 alone.⁶¹

The Southeast Asian FFF phenomenon appears rooted in the Afghan mujahedeen experience. Across the region there are numerous examples of veteran mujahedeen who returned from Afghanistan not only with their experiences, but with networks and with a new brand of Wahhabi fundamentalism. Prior to the influx of returning foreign fighters Southeast Asian insurgent networks were not very interconnected and focused primarily on domestic issues driven more by ethno-nationalist than Salafist agendas. Major pre-MAK insurgent Islamist groups were limited to the Moro National Liberation Front

⁶⁰ Thomas Hegghammer, “The Rise of Muslim Foreign Fighters: Islam and the Globalization of Jihad.” *International Security* 35, no. 3 (2010): 58.

⁶¹ Ressa, Maria. *Seeds of terror: An eyewitness account of Al-Qaeda’s newest center of operations in Southeast Asia*, (New York: Free Press, 2003), 126.

(MILF) in the Philippines,⁶² The Wae Ka Rae (WKR) in Thailand,⁶³ and the associated movements of Darul Islam (DI)⁶⁴ and Dewan Dakwah Islamiyah Indonesia (DDII).⁶⁵

The impact of the mujahedeen experience on radicalization had broad implications throughout Southeast Asia. Solaiman Santo notes that “all of Jemaah Islamiyah’s (JI) top leaders and many of its bombers trained in mujahedeen (Islamic warrior) camps in Afghanistan from 1985 to 1995.”⁶⁶ The networks and relationships established as a result of Afghani mujahedeen may have been one of the most significant contributors to the emergence of regional violent extremism in Southeast Asia, significant in that they opened the door for training and lead to habitual relationships as well as the sharing of resources and TTPs. These newly developed ties lead to mutual support, even in instances where ideology and objectives differed significantly between groups. For example, the MILF (who retained a primarily domestic agenda) maintained a tactical alliance with Al Qaeda through Mohammed Jamal Khalifa (Usama Bin Laden’s brother in law.) In fact, without the MAK mujahedeen connection, it is possible that Al Qaeda might not have established a presence in the Philippines.

Global FFF continued during the Bosnian War, and the U.S. led occupation of Iraq and Afghanistan. Specific figures on the number of Southeast Asians who

62 The MILF is a Filipino Islamist group that advocated for secession from the Philippines since its inception in 1978. Over the years the organization has come in and out of political legitimacy and has used violence in pursuit of its objectives. (Mapping Militant Organizations/Stanford University, <http://web.stanford.edu/group/mappingmilitants/cgi-bin/groups/view/309>).

63 WKR is a Thai criminal organization that is thought to have some ties to JI and al-Qaeda (Zachary Abuza, “Al Qaeda Comes to Southeast Asia,” in *Terrorism and Violence in Southeast Asia: Transnational Challenges to States and Regional Stability*, ed. Paul J. Smith, (New York: Routledge, September 2004), 50.

64 Darul Islam was founded by Sekarmadji Kartosoewirjo in 1949. It is considered to be the inspiration for all violent and non-violent groups who seek an Islamic state in Southeast Asia and has spawned groups like, Jemaah Islamiyah and Ring Banten (International Crisis Group, <http://www.crisisgroup.org/en/regions/asia/south-east-asia/indonesia/op-eds/jones-darul-islams-ongoing-appeal.aspx>).

65 DDII, aka Indonesian Islamic Propagation Council, was founded by Agus Dwikarna. DDII was the founding organization for KOMPAK (Zachary Abuza, *Militant Islam in Southeast Asia: Crucible of Terror*, (Boulder CO: Lynne Rienner Publishers, 2003), 147).

66 Soliman M. Santos, Jr. and Paz Verdades M. Santos “Jemaah Islamiyah (JI) and Other Indonesian/Malaysian Jihadi Groups,” in *Primed and Purposeful: Armed Groups and Human Security Efforts in the Philippines*,” ed. Diana Rodriguez, Small Arms Survey Graduate Institute of International and Development Studies, (Geneva, Switzerland, 2010), 408.

participated in these conflicts is sparse but research indicates that Southeast Asian FFF support was extremely limited compared to the Soviet Afghan occupation.⁶⁷ During this period members of the FFF network assumed a Southeast Asian regional focus signified by regional transnational terrorist attacks and insurgent activity.⁶⁸

Following the U.S. withdrawal from Iraq in 2010, Southeast Asian extremist organizations began to evolve. In the middle of 2010, one of the main training camps for fighters in Southeast Asia was broken up in Aceh. Prior to this, training was conducted in mass hosted by one or more jihadi groups. Members from multiple organizations used these training camps to disseminate paramilitary and theological instruction. Local imams were invited to teach regardless of their affiliation with extremist organizations. Following the 2010 raid, Aceh escapees began to spread their ideology while hiding with unaffiliated sympathizers, expanding a network of grassroots based ideological hubs.⁶⁹ This reflects what appears to be a trend of individuals promoting jihad without any official organizational affiliation.⁷⁰

A second major adjustment in the way the Southeast Asian FFF network operated was in how they obtained and distribute printed recruiting material. While there is a history of digital and print propaganda among jihadi groups—ISIL publishes *Dabiq* magazine and Al Qaeda published a magazine called *Inspire*—extremist publishing in Southeast Asia may be unique. The Southeast Asian FFF network tends to copy jihadi materials from the Middle East, using a network of locally incarcerated extremists to translate the works. Once translated, they are then published in Malaysia, Indonesia, and the Philippines through a network of sympathetic publishing companies.⁷¹ This process requires the dropping off and picking up of documents from prisons, apparently with the

67 Christopher Jasparro, “Geographic Perspectives on the Sociocultural, Economic, and Demographic Aspects of Counterterrorism,” in *Essentials of Counterterrorism* ed. James J. F. Forest (Santa Barbara, CA, ABC-CLIO Incorporated, 2015), 53–61.

68 Christopher Jasparro, “Geographic Perspectives on the Sociocultural, Economic, and Demographic Aspects of Counterterrorism,” 60–61.

69 “Indonesia: How Indonesian Extremists Regroup,” *ICG Asia Report* 228 (July 2012).

70 Relational data from the Southeast Asian FFF dataset supports the notion that several individuals attending training camps in Poso after 2010 were unaffiliated.

71 “Indonesia: Jemaah Islamiyah’s Publishing Industry,” *ICG Asia Report* no. 147, 28 February 2008.

complete knowledge of government/prison officials. While the publishing companies are not directly tied to JI, the “school and family ties of leading publishers bridge factional and organizational divisions.”⁷² Throughout the evolution of Southeast Asia’s FFF networks, bright individuals, and legitimate businesses and sociopolitical organizations often played critical roles as silent partners in jihad.

2. Noordin Top Terrorist Network

The Noordin Top network was an Indonesia-based Salafi jihadist organization with ties to Al Qaeda in Southeast Asia. It was active in Southeast Asia between the years 2000 and 2010 lead by Noordin Mohamed Top. The group began as a JI splinter group and gained infamy in 2003 following a high profile bomb attack on the JW Marriot Hotel in Jakarta, Indonesia, and became defunct following Noordin Top’s death in 2009.⁷³ At its peak the Noordin Top network was able to secure the support from the surrounding population oftentimes through previously established ties to members of JI from a broad network of returned Afghan veterans, and from a dispersed network of religious boarding schools referred to in the regional parlance as pondoks or pesantren.⁷⁴

According to the International Crisis Group, Noordin saw himself as the head of JI’s military wing and claimed to be the head of Al Qaeda in the Malay Archipelago.⁷⁵ Noordin’s introduction to the jihadi sphere was through his attendance at the Lukmanul Hakim pesantren in Malaysia.⁷⁶ Under the mentorship of Muklahs, one of the JI leaders responsible for the first Bali bombings (hereafter referred to as Bali I), Noordin

⁷² Ibid., 13.

⁷³ Jemaah Islamiyah is an Islamic activist group and one of Southeast Asia’s largest jihadist organizations. During the period in which Noordin’s network was active JI leaders disagreed on whether to provide support to Noordin’s Activities. (International Crisis Group, “Terror in Indonesia: Noordin’s Networks”).

⁷⁴ International Crisis Group, “Terror in Indonesia: Noordin’s Networks.”

⁷⁵ Ibid., 1.

⁷⁶ The Lukmanul pesantren was essentially a Malaysian clone of the Al Mumkin pesantren described earlier in this chapter.

transitioned from student to Lukmanul Hakim's director.⁷⁷ Although the school closed in 2002 prior to the start of Noordin's network mobilization, the relationships he forged while at the school would prove a critical enabler of Noordin's future Terrorist activity.⁷⁸

As a former JI member, Noordin Top had access to a wide range of latent JI network connections and resources. However, analysis of Noordin's case study reveals a few important distinctions between Noordin's group and the larger JI organization. The first resulted from Noordin's continued instance on operating outside of JI control and guidance. This limited Noordin's access to the resources of important network hubs such as Abdullah Sunata and Akram alias Taufikurrahman who maintained operational loyalties to JI.⁷⁹ A second notable difference between the Noordin Top and JI Networks is that Noordin's Network included ties to entities and groups to which JI had little or no operational affiliation such as the Banten Ring (aka the Ring Banten Group).⁸⁰ Although Noordin was able to mobilize external support through individual elements of tangential networks of all varieties he failed to successfully recruit bloc support from existing organizations legitimate or otherwise.

3. PIRA Network

PIRA was a dark network composed of Irish Catholics in Northern Ireland who violently protested their unfair treatment by the British-controlled government. It originated from the original Irish Republican Army (old IRA), which was active from 1916 to 1920. This early insurgency successfully challenged British rule and succeeded in establishing a free Irish State in 1921. This state's formation split six northern Irish counties from the rest of Ireland and set the stage for a bloody civil war that lasted from June 1922 until May 1923. The free state government won the civil war and the six

⁷⁷ The first Bali Bombings was a combined attack involving a suicide vest, and suicide vehicle borne improvised explosive device (SVBIED). The bombs detonated in October 2003 targeting patrons of a nightclub in Bali Indonesia. The attack killed 202 people. Although several members of Noordin's Network including Umar Patek, Dulmatin, and Abu Dujana are believed to have been involved the attack, planning coordination and execution was conducted by JI. (International Crisis Group, "Terror in Indonesia: Noordin's Networks).

⁷⁸ International Crisis Group, "Terrorism in Indonesia: Noordin's Networks."

⁷⁹ Ibid.

⁸⁰ Ibid.

northern counties remained under British rule.⁸¹ The IRA capitulated, but never disarmed. After the civil war, the IRA continued struggling against the free state and Northern Ireland, eventually being outlawed by both Irish governments. It went so far as to try and gain support from Adolph Hitler during WWII. After the World War, the movement continued to struggle to establish equal rights for Irish Catholics.⁸² During the 1960's discrimination against Irish Catholics in the "British-Ruled" predominately protestant controlled government had begun to take a toll on the people.⁸³ Kathryn Gregory notes that "In the North, the Catholic minority, many of them with '*republican*' or '*nationalist sympathies*,' found they faced discrimination for jobs, housing, and in their treatment before the law. On the other side, Protestant '*unionists*' held sway, controlled the patronage that doled out government jobs, and remained fiercely loyal to the British crown."⁸⁴ In December of 1969, the IRA broke into two groups, the Official and the Provisional wings. The Provisional wing believed that violence and terrorism were the keys to forcing the British out of Ireland.⁸⁵

By the 1970's, relations between the Irish and British governments were still very tense. As tensions rose, PIRA began to conduct terror attacks, such as shootings, assassinations, and bombings. These tactics hurt popular support for PIRA, even from the people they were fighting to liberate.⁸⁶ Then, in January 1972, a British paratrooper regiment open fired on a group of unarmed civil rights protestors, killing thirteen at a Catholic rally in Londonderry.⁸⁷ After this event, later dubbed *Bloody Sunday*, PIRA

81 Kathryn Gregory, Provisional Irish Republican Army (IRA) (aka, PIRA, "the provos," Óglaigh na hÉireann) (UK separatists), Council on Foreign Relations, Mar 16, 2010, 1.

82 Encyclopedia Britannica, s.v. "Irish Republican Army (IRA)," ed. Kimberly Cowell-Meyers and Paul Arthur, <http://www.britannica.com/topic/Irish-Republican-Army>.

83 Kathryn Gregory, Provisional Irish Republican Army (IRA) (aka, PIRA, "the provos," Óglaigh na hÉireann) (UK separatists), 1.

84 Ibid.

85 Encyclopedia Britannica, s.v. "Irish Republican Army (IRA)," ed. Kimberly Cowell-Meyers and Paul Arthur, <http://www.britannica.com/topic/Irish-Republican-Army>.

86 Ibid.

87 Gill, Paul; Lee, Jeongyoon; Rethemeyer, Karl R.; Horgan, John; Asal, Victor, "Lethal Connections: The Determinants of Network Connections in the Provisional Irish Republican Army, 1970–1998," <http://dx.doi.org/10.7910/DVN/25575> V1 [Version]. 55.

recruitment soared.⁸⁸ In July of that same year PIRA conducted a series of coordinated attacks on what became known as *Bloody Friday* where “downtown Belfast was rocked by twenty-two bombs in seventy-five minutes, leaving nine dead and 130 injured.”⁸⁹ PIRA’s strategy during this period was to “quickly force British troops out of Northern Ireland by inflicting a high death toll and substantial economic costs,”⁹⁰ in order to change British public opinion against maintaining ties with Northern Ireland.⁹¹

Over the next twenty plus years more than 3,600 individuals would be killed (on both sides). In 1974 PIRA established a non-violent political wing, Sinn Féin, or “Ourselves Alone” as it translates from Gaelic, which achieved a level of success in establishing legitimacy by occupying various positions within the provincial Northern Irish government.⁹² During this period, the Irish Northern Aid Committee (NORAI) began conducting fund-raising for the families of Irish political prisoners.⁹³ Sinn Féin persisted as PIRA’s political arm until April 1998 when a final peace agreement was made.⁹⁴

During the three decades between 1970 and 1998, PIRA was considered one of the most dangerous terrorist organizations in the world. It developed the use of improvised explosive devices (IED) years before the United States would encounter them in Iraq. It also used criminal activity “such as extortion, bank robbery, smuggling, and counterfeiting” to help finance its operations.⁹⁵ Nevertheless, PIRA managed to transition from terrorist activities to laying down their arms and return to peaceful

⁸⁸ Ibid., 55.

⁸⁹ Ibid.

⁹⁰ Ibid., 55.

⁹¹ Ibid., 55.

⁹² Sinn Féin was recognized legally in May of 1994, it has been in existence in some form since around 1918 and the old IRA.

⁹³ NORAI is an independent, New York based charitable organization founded by Michael Flannery. It conducts fund-raising to distribute charitable relief to the families of Irish political prisoners. Often suspected of having ties to PIRA. Warren Richey, “On the trail of U.S. funds for IRA,” *The Christian Science Monitor*, Jan 14, 1985, <http://www.csmonitor.com/1985/0114/anor1.html>

⁹⁴ Kathryn Gregory, Provisional Irish Republican Army (IRA) (aka, PIRA, “the provos,” Óglaigh na hÉireann) (UK separatists)

⁹⁵ Ibid.

members of society. The movement went so far as to actually try and convey to the population that the conflict was finally behind them; “In July 2002, on the thirtieth anniversary of the 1972 *Bloody Friday* bombings, the IRA (aka PIRA) startled its sympathizers and enemies alike by offering ‘sincere apologies and condolences’ to the families of its civilian victims.”⁹⁶

This chapter has provided an overview of three unique dark networks that have drawn support from their surrounding societies. The following two chapters (Chapter V and VI) build upon this framework to evaluate the effect of this support on measures of network efficiency.

⁹⁶ Ibid., 2.

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V. QUANTITATIVE ANALYSIS

This chapter provides a quantitative network level social network analysis (SNA) based on metric descriptions of network snapshots over time. The objective of this analysis is to assess the statistical relationship between embeddedness, as measured by E-I index, and structural efficiency, as measured by density, centralization, and average degree centrality. This chapter is divided into four sections, each focused on a different empirical network case study.⁹⁷ Sections are further divided into three subsections, comprising longitudinal descriptions of network change, statistical descriptions of the network, and a correlational analysis of network level measures. Within this analysis actual empirical network data is contrasted with the results from simulated networks.

The simulated networks used throughout this chapter were generated by sampling the network data (nodes, edges, and attributes) from each observation period. The sample variables were then permuted 5,000 times using the Monte Carlo method, producing a set of 5,000 row arrays (one for each network observation). In instances in which simulated metrics for data are represented as scalar values the analysis uses the mean value for each simulated observation interval. This process produces data that provides a benchmark for network statistics and topography and provides a context for interpreting the empirical network values. That is to say that simulated results are used to assess the extent that changes in the empirical network are being influenced by sociological phenomenon or external events. It should be noted that the simulated networks enjoy significantly higher degrees of endogenous freedom than is available within the empirical datasets. This will produce narrower confidence intervals during correlational analysis.

In order to measure the effects of external linkages on dark network structure it is necessary to isolate dark nodes from the remainder of the network while calculating relevant topographic measures. As such, all measurements within this chapter, with the exception of E-I index, are based exclusively on dark entities and relationships. Bright entities and their associated linkages are used to calculate embeddedness by means of

⁹⁷ As in the previous chapter, networks surveyed in this chapter include the Noordin Top Terrorist Network, the Southeast Asian FFF Network and the PIRA network.

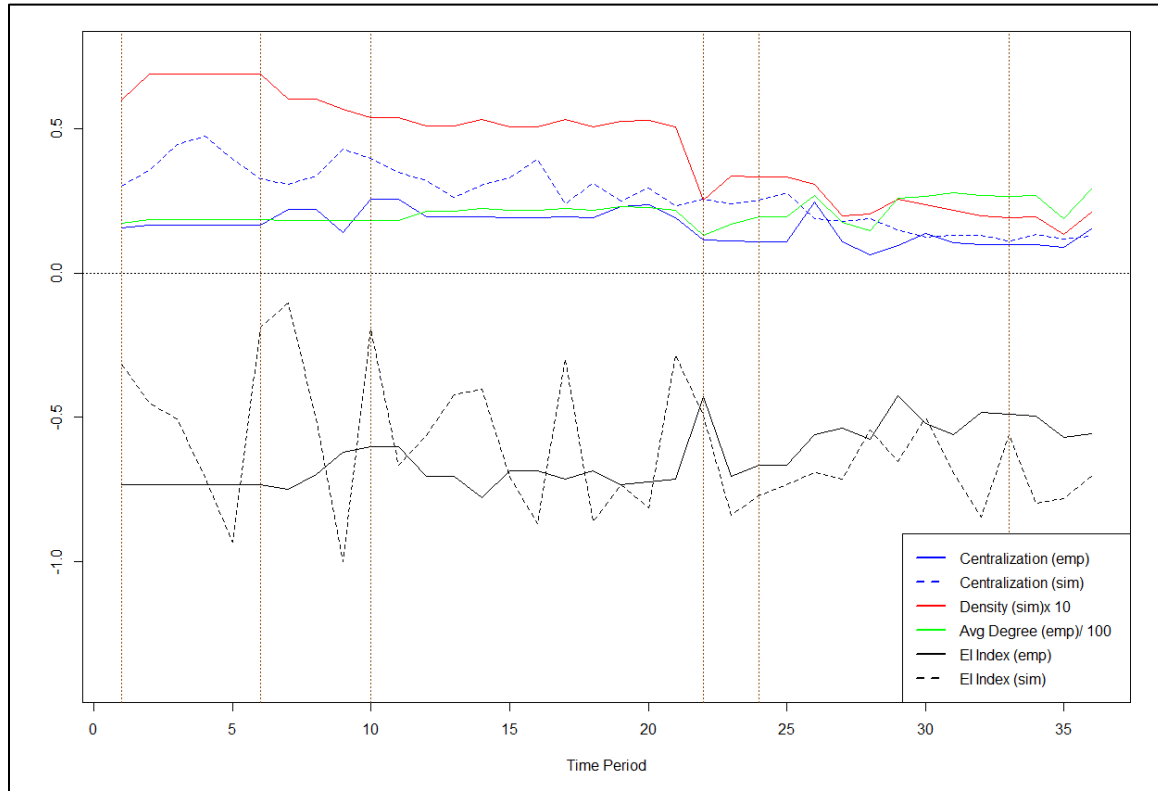
group E-I index but are subsequently removed prior to calculating centralization, density, and average degree centrality. As a result of this intentional methodological variance, graphs and figures will likely differ from previous publications evaluating similar metrics.

A. SOUTHEAST ASIAN FFF NETWORK

Figure 4 provides a graph depicting the density, average degree centrality, centralization, and group E-I index for the dark components of the Southeast Asian FFF Network. Simulated scores are the mean of the permuted values. In order to improve graph readability, density scores have been multiplied by 10, and average degree values have been divided by 100. Observations span from the year 1980 to 2015 with significant events marked by dotted vertical lines. Based on data availability network membership studied is limited to high profile network members and individuals with links to them. Significant events are indicated with brown dotted lines and include the Soviet invasion of Afghanistan (1980), Sungkar begins sending fighters to Afghanistan (1986), the Soviet departure from Afghanistan (1989), the September 11th World trade center attacks and the Malaysian terrorism crackdown (2001), the Indonesian terrorism crackdown (2003), and the rise of ISIS (2012).

Over the 36-year period studied, centralization remains relatively stable, density follows a slight decline due to increases in network size. Both average degree and E-I index trend slightly upward. Empirical measures manifest less variation than is observed across simulated data. The most noticeable variations observed of any individual year occur in 2001. During this period the E-I index peaked while measures of the provincial cosmopolitan dimensions as well as centralization sharply decreased. Available data is insufficient to suggest any specific case for this phenomenon; however, increased focus on Islamic extremism in Malaysia, and the southern Philippines in the months leading up to and following the September 11th terrorist attacks may play a role. Although provincial-cosmopolitan scores quickly rebound, centralization remains low until 2005 where it begins to converge with density and average degree.

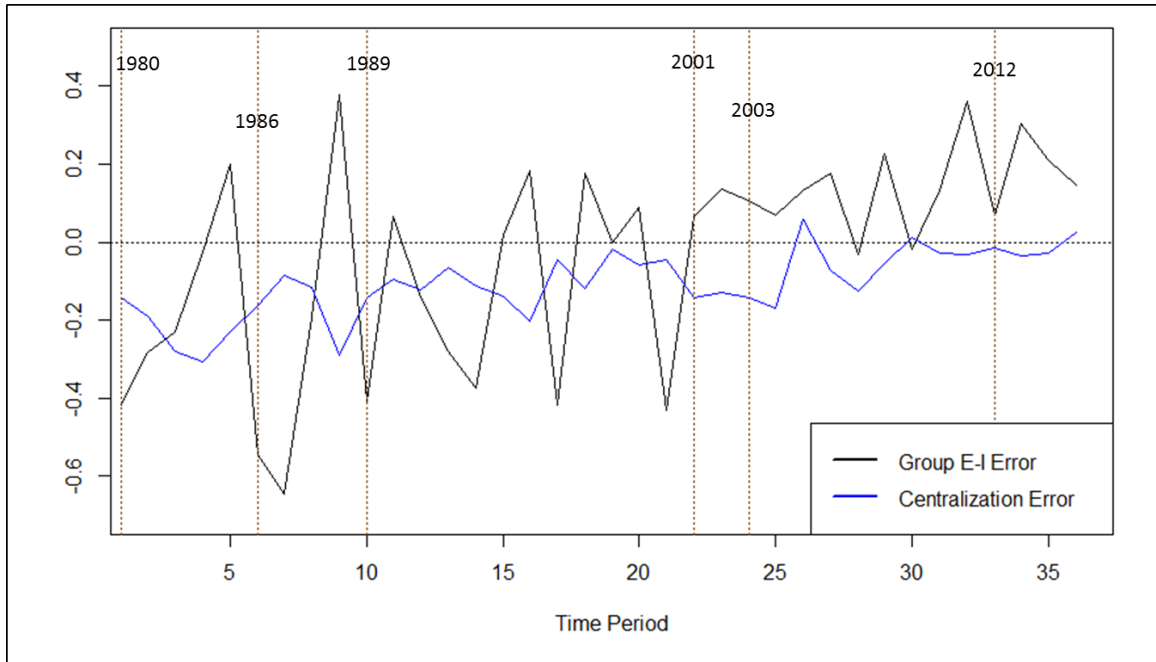
Figure 4. Southeast Asian FFF Network Statistics (Density, Average Degree, Density, and Group E-I)



From left to right significant years are: the Soviet invasion of Afghanistan (1980), Sungkar begins sending fighters to Afghanistan (1986) the Soviet departure from Afghanistan (1989), September 11th attacks and the Malaysian crackdown on terrorism (2001), the Indonesian Crackdown in Terrorism (2003) the rise of ISIL 2012.

Figure 5 depicts the error between empirical and simulated measures of centralization and the E-I index. Error scores are calculated by subtracting the simulated values from the empirical values. The E-I Index values greater than one indicate periods in which the empirical E-I scores are lower than simulated and values less than one indicate periods where empirical scores were higher than simulated. Periods of greater deviation are further from the x-axis (0). The same relationship is true for positive and negative centralization error scores. Figure 5 indicates that over time the error between empirical and simulated network measures generally trended upwards, with values in the final observation periods displaying a tendency for the network to manifest as slightly more centralized and embedded than the simulated networks.

Figure 5. Southeast Asian FFF Network, Group E-I Index Error

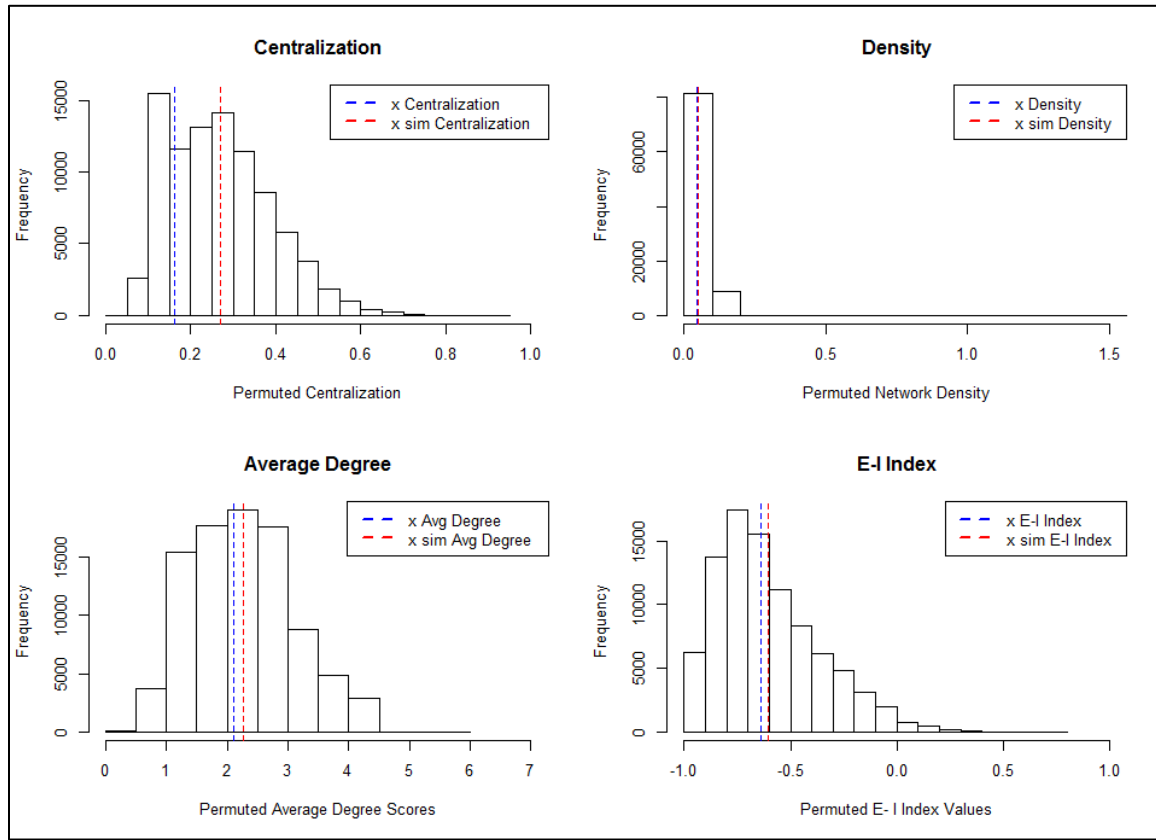


From left to right, significant years are: the Soviet invasion of Afghanistan (1980), Sungkar begins sending fighters to Afghanistan (1986) the Soviet departure from Afghanistan (1989), September 11th attacks and the Malaysian crackdown on terrorism (2001), the Indonesian Crackdown in Terrorism (2003) the rise of ISIL 2012.

1. Southeast Asian FFF Network Statistics Summary

Figure 6 depicts four histograms representing the distribution of the permuted network measurements for the FFF network across all 36 observation periods. Vertical lines represent the frequency with which a simulated network values were observed. Mean empirical and simulated scores for each network measure are depicted with dotted vertical lines. Visual analysis of the graphs suggests that permuted results for centralization, density, and E-I index skew to the left. The distribution of permuted network values suggests that on average a network sharing the same number of ties, nodes and attributes as the FFF Network would tend to be relatively decentralized, cosmopolitan, and insulated with more internal than external ties. Across all measures, the mean scores for embeddedness and efficiency within the empirical network fell close to mean permuted values.

Figure 6. Southeast Asian FFF Network Statistics Distribution Summary



Southeast Asian FFF Network, 90,000 permutations.

2. Southeast Asian FFF Correlational Analysis

Figure 7 and Table 1 provide graphic and metric descriptions of the sample estimates and confidence intervals for correlation between E-I index and efficiency measures. E-I index correlates negatively with density and centralization and positively with average degree centrality.⁹⁸ Within the empirical network, sample estimates for centralization correlate more negatively with embeddedness than those of the permuted

⁹⁸ The unexpected disparity between correlations for density and average degree can be explained by a visual analysis of Figure 4. As the network grew over time the average number of connections remained relatively stable with just over two. Meanwhile the total number of nodes in the network steadily increased resulting in lower density values over time. This disparity highlights the limitation associated with comparing density between networks of differing size. Given the discrepancy between the two measures of the FFF network's provincial cosmopolitan dimension analysis of the FFF network will rely on average degree centrality as a measure of the provincial cosmopolitan dimension and ignore density scores. (Average degree centrality is less sensitive to variations in network size and is a more reliable measurement of the provincial cosmopolitan dimension of network structure in instances when deviations in the size of compared networks is a factor.)

network with coefficient difference of -0.50. This finding runs counter to the hypothesized relationship between embeddedness and efficiency as defined by network centralization. The initial theory behind this research as informed by Milward and Raab, Everton and Cunningham, and others was that dark networks trade security for efficiency by maintaining sparse decentralized network structures, and that popular support (external ties) would reduce security requirements thereby leading to increases in centralization and network density.⁹⁹

In contrast to centralization, group E-I index correlates positively with connectedness (as estimated by average degree centrality). This relationship is supportive of the initial hypothesis especially considering the nonconformity between the empirical and simulated results. In the case of average degree centrality the absolute value of the difference between sample estimates was 1.05. The implications of these observations are that bright connections within the FFF network contributed simultaneously to decentralization and interconnectivity. It remains unclear whether these effects resulted in a network that was overall more or less structurally efficient.

⁹⁹ Brinton H. Milward, Jörg Raab, "Dark Networks as Organizational Problems: Elements of A Theory," 333–360. Sean F. Everton, and Dan Cunningham. "Terrorist network adaptation to a changing environment," 287–308.

Figure 7. Southeast Asian FFF Network Correlation Coefficient Confidence Intervals (Group E-I)

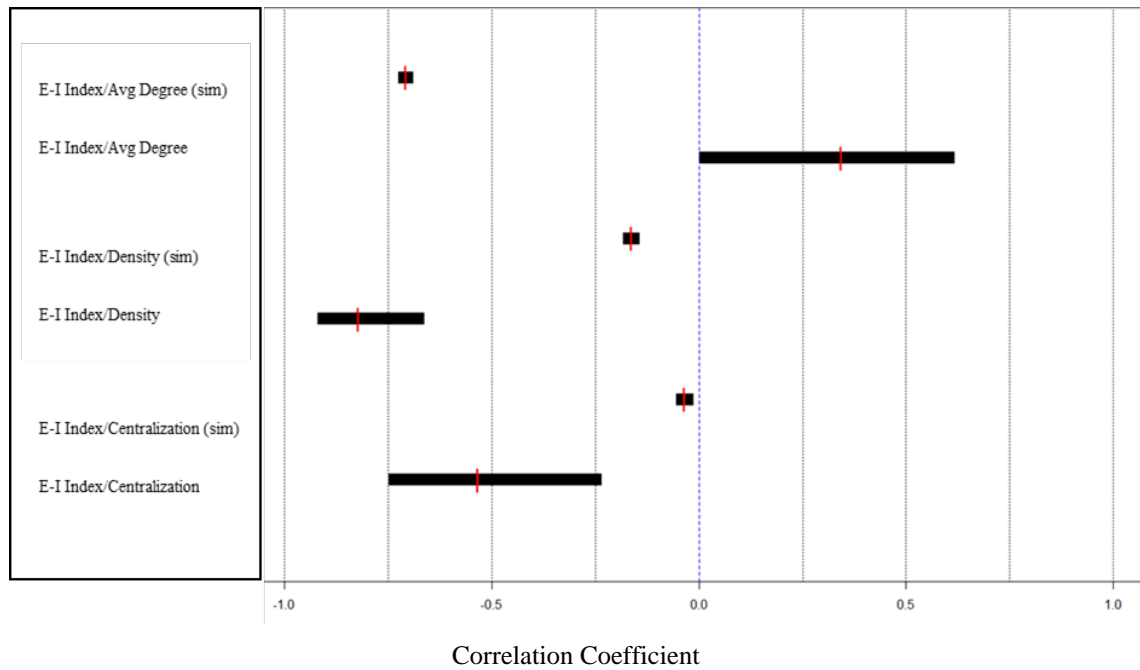


Table 1. Southeast Asian FFF Network Pearson's Product Moment Correlation

	Pearson's Product-Moment Correlation		
	95 Percent Confidence Interval		
Group E-I Index and:	Min	Max	Sample Estimates
Average degree (Simulated)	-0.711	-0.705	-0.708**
Average degree (Empirical)	0.015	0.602	0.342*
Density (Simulated)	-0.17	-0.157	-0.164**
Density (Empirical)	-0.907	-0.678	-0.823**
Centralization (Simulated)	-0.042	-0.029	-0.036**
Centralization (Empirical)	-0.734	-0.25	-0.535*

** p -Value < 0.0001, * p -Value < .05

B. NOORDIN TOP NETWORK

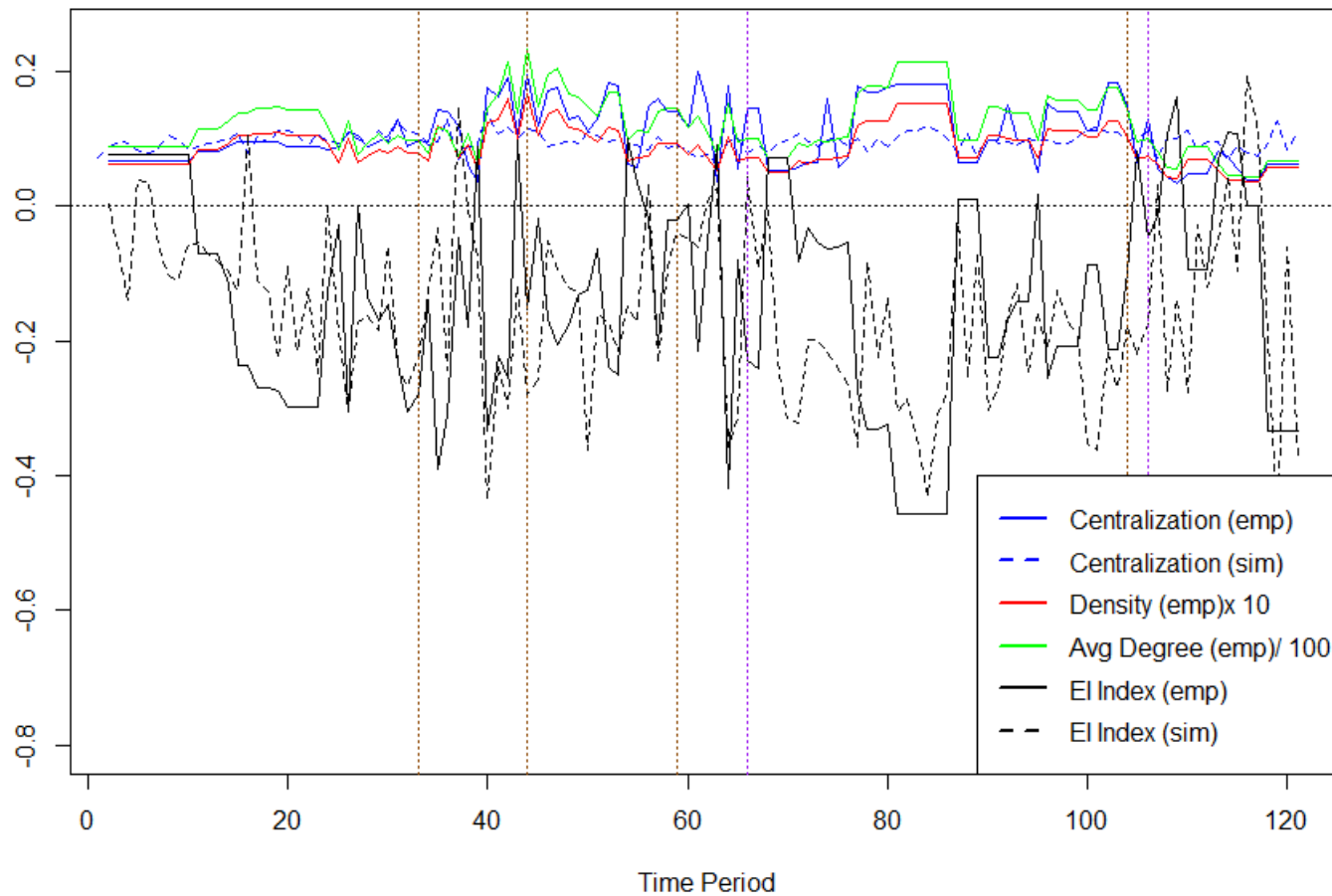
Figure 8 provides a graph depicting longitudinal variation within dark components of the Noordin Top Terrorist Network, using the same measures evaluated in the Southeast Asian FFF network.¹⁰⁰ Simulated scores are the mean of the permuted values. As before in order to improve graph readability, density scores have been multiplied by 10, and average degree values have been divided by 100. Observations span from the year 2000 to 2010 with significant events marked by dotted vertical lines, Noordin lead attacks are indicated in brown and important arrests and deaths are indicated in purple.¹⁰¹ The topographic measures of both the empirically observed and simulated networks appear to manifest stochastically across the observation period.

E-I index values are generally negative with sporadic peaks. The peaks in E-I index occur in the months preceding and following attacks, with a tendency for post attack peaks to be slightly higher than pre-attack peaks. The attacks themselves tend to occur during periods in which the organization's group embeddedness is close to neutral, i.e., the number of external (bright or shady) ties are similar to the total number of ties to internal (dark) ties. Given the Noordin network's tendency towards an insulated structure, these neutral values represent points of relative embeddedness. As was observed with the group E-I index, centralization and density within the dark components of the network also increase in the periods preceding and following a successful attack. Compared to the E-I index observations these increases are more subtle and tend to fall temporally closer to the point of attack.

¹⁰⁰ Measures represented include density, average degree centrality, centralization and group E-I index.

¹⁰¹ Significant events include the Marriott Hotel bombing (August 2003), the Australian Embassy bombing (September 2004), the second Bali bombings (October 2005), Arrest of Jabir and other key operatives (September 2006) the Jakarta Hotel bombings (July 2009), and the death of Noordin top (August 2009).

Figure 8. Noordin Network Statistics (Density, Average Degree, Density, and Group EI)



Significant events include the Marriott Hotel bombing (August 2003), the Australian Embassy bombing (September 2004), the second Bali bombings (October 2005), Arrest of Jabir and other key operatives (September 2006) the Jakarta Hotel bombings (July 2009), and the death of Noordin top (August 2009).

As indicated by Figure 8, there are multiple periods where the empirically observed E-I index deviates substantially from the simulated mean. Contextual analysis of the larger deviations suggests a combination of both exogenous and endogenous forces may be responsible. Figure 9 provides a less cluttered depiction of the deviation (error between empirical and simulated group E-I index values). As before, positive values indicate periods where the empirical network was more embedded than the simulated network and negative values represent periods where the empirical network was less embedded than the simulated network. Figure 9 also depicts periods in which Noordin network members were either killed or arrested by law enforcement entities. Arrest statistics provide an objective external variable for contentedness, which may help to explain significant deviations between the two E-I variables and is depicted by a solid purple line. For the purposes of analysis, Figure 9 also highlights four instances where the deviations in E-I index were statistically significant at the 95 percent confidence level. These instances are depicted by red circles and are numbered from one to four in order of magnitude.

The largest statistically significant deviation in E-I index occurs on September 2006. In this period, Noordin's network is considerably more embedded than the simulation. This deviation comes on the heels of the arrest of five members of Noordin's Network and the deaths of Jabir: a well-connected bomb maker and close confidant of Noordin and Baharudin Soleh: one of Noordin's recruiters.¹⁰² This police action appears to have had significant effect on Noordin's organization as the group does not conduct another high profile attack for three years following the action.

The second largest deviation occurs in November 2009. As with the first spike, it represents a period of heightened embeddedness. This spike occurs following the death of Noordin Top, Urwah, and Mistam Husmudin, which ultimately lead to the dissolution of the network. Increases in embeddedness in the periods following the law enforcement actions in September 2006 and November 2009 may be indicative of dark network

¹⁰² Those arrested or killed included: Baharudin Soleh, Hence Malewa, Iqbal Huseini, Jabir, Mustagfirin, Purnama Purta, and Solahudin. "Terrorism in Indonesia: Noordin's Networks," *International Crisis Group, Asia Report* 114, (May 2006).

members reaching out to bright members in the community for information, resources or safe haven.

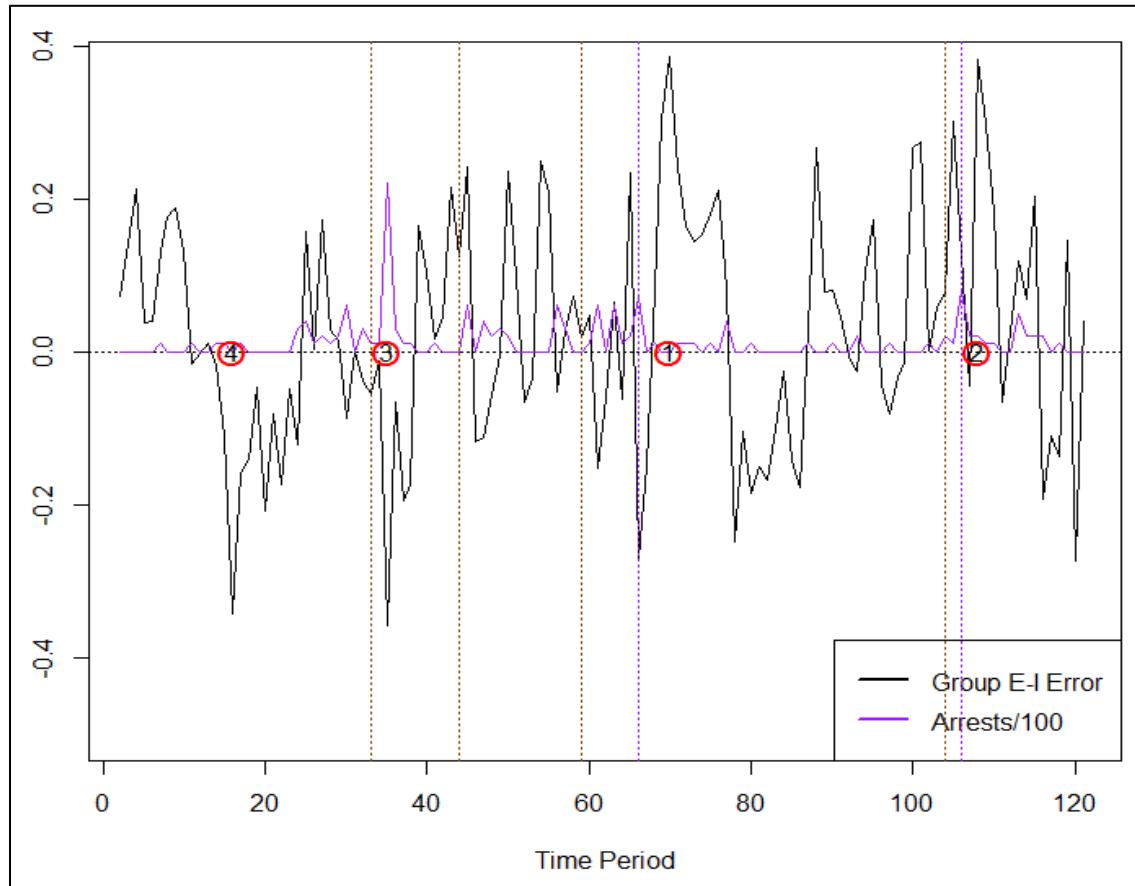
The third significant deviation occurs in October 2003 when 22 members of Noordin's network were arrested in a single month. In this case, Noordin's network is significantly less embedded than the simulation. Variation in this period is the direct result of the removal of a large number of previously connected nodes from the network rather than a post hoc response. Such a response does occur and can be observed in the periods following the arrests as a series of spikes in embeddedness.¹⁰³

The fourth significant deviation occurs in March 2002 and does not coincide with high level arrests or with heightened police activity. As this deviation occurs prior to the first Bali bombing during a period where Noordin's network was still in its infancy and was relatively unknown among law enforcement. It is possible that this dip simply represents a period of internal organization, which would account for the low group E-I score. According to the International Crisis Group, "There is little indication that Noordin's band of diehard followers had any particular structure at this stage."¹⁰⁴

¹⁰³ Although the spikes following the October arrests are observable they are not statistically significant.

¹⁰⁴ International Crisis Group, "Terrorism in Indonesia: Noordin's Networks," 11.

Figure 9. Noordin Network Statistics (E-I Index and Arrest Data)



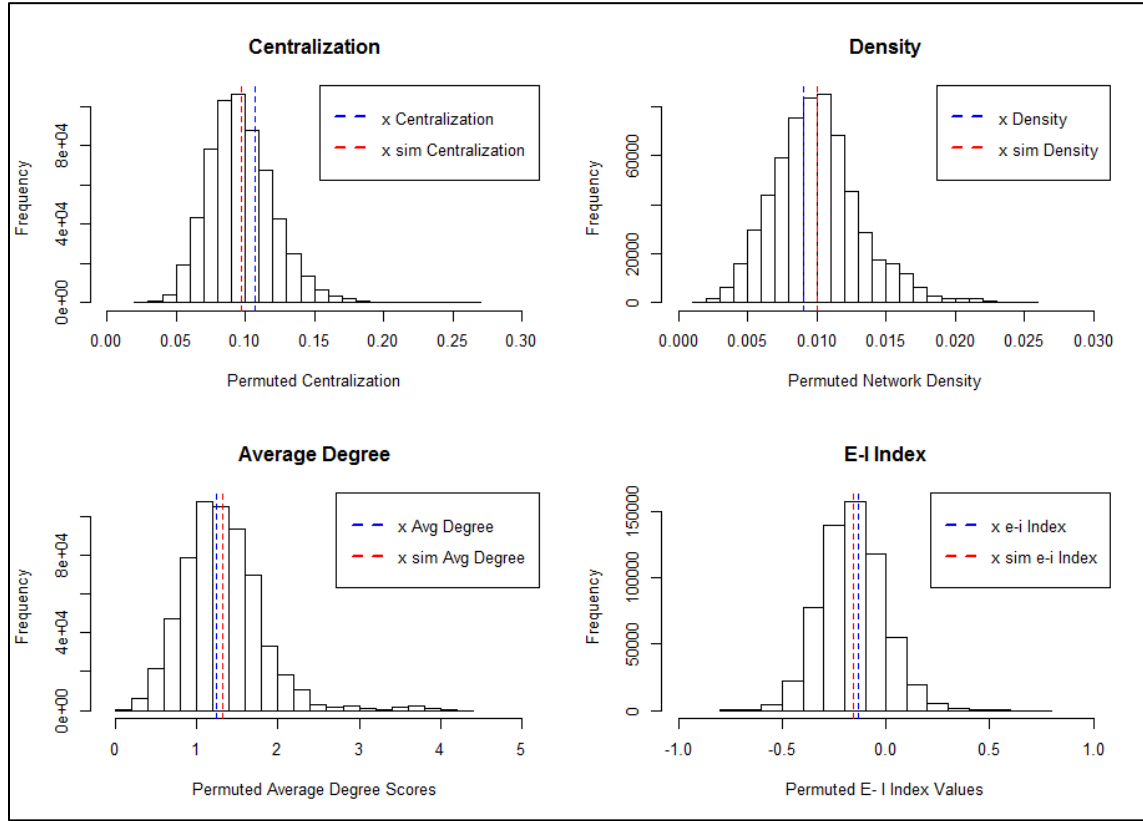
From left to right significant events and arrests are August 2003, July 2004, and October 2005, July and September 2006, and September 2009. Significant E-I index error is numbered by decreasing magnitude.

1. Noordin Top Network Statistics Summary

Figure 10 provides four histograms representing the distribution of the permuted network measurements for the Noordin Top network across all 120 observation periods. Vertical bars represent the frequency with which simulated network values were observed. Mean empirical and simulated scores for each network measure are depicted with dotted vertical lines. Visual analysis of the graphs shows that permuted results are normally distributed for all four measures. The distribution of permuted network values suggests that on average a structurally similar random network would tend to be relatively decentralized, cosmopolitan, and insulated with more internal than external ties. The graphs in Figure 10 also suggests that across all measures the mean scores for embeddedness and efficiency within the empirical network fell close to mean permuted

values. When compared to the simulated network Noordin's network was on average slightly more centralized, and more sparsely and outwardly connected.

Figure 10. Noordin Network Statistics Distribution Summary



Noordin Network 605,000 Permutations

2. Noordin Top Correlational Analysis

Figure 11 and Table 2 provide graphic and metric descriptions of the sample estimates and confidence intervals for the correlation between E-I index and efficiency measures. E-I index correlates negatively with all three sets of measures. Sample estimates for the empirical network measures correlate more negatively with embeddedness than those of the permuted network. As with the Southeast Asian FFF network these findings run counter to the original hypothesis. Again, higher group E-I index values corresponded with lower centralization and density scores; and in the case

of the Noordin network specifically, also corresponded to lower average degree centrality.

On average, sample estimates for correlation between simulated network data fell within 20 percent of those between empirical values. The statistical significance of the difference in sample estimates is most pronounced for centralization and density. In the case of centralization there is no overlap between the empirical and permuted sample estimate ranges, and in the case of density the empirical confidence interval fall outside the sample estimate range for the permuted networks. The implications of these findings are twofold. The first is that the underlying network parameters within Noordin's network create a tendency for a negative correlation between embeddedness and efficiency, which supersedes social behavior. The second is that some combination of actual internal or external factors may have served to amplify this disposed negative relationship within the social behavior of the Noordin Top Network.

Figure 11. Noordin Correlation Coefficient Confidence Intervals (Group E-I)

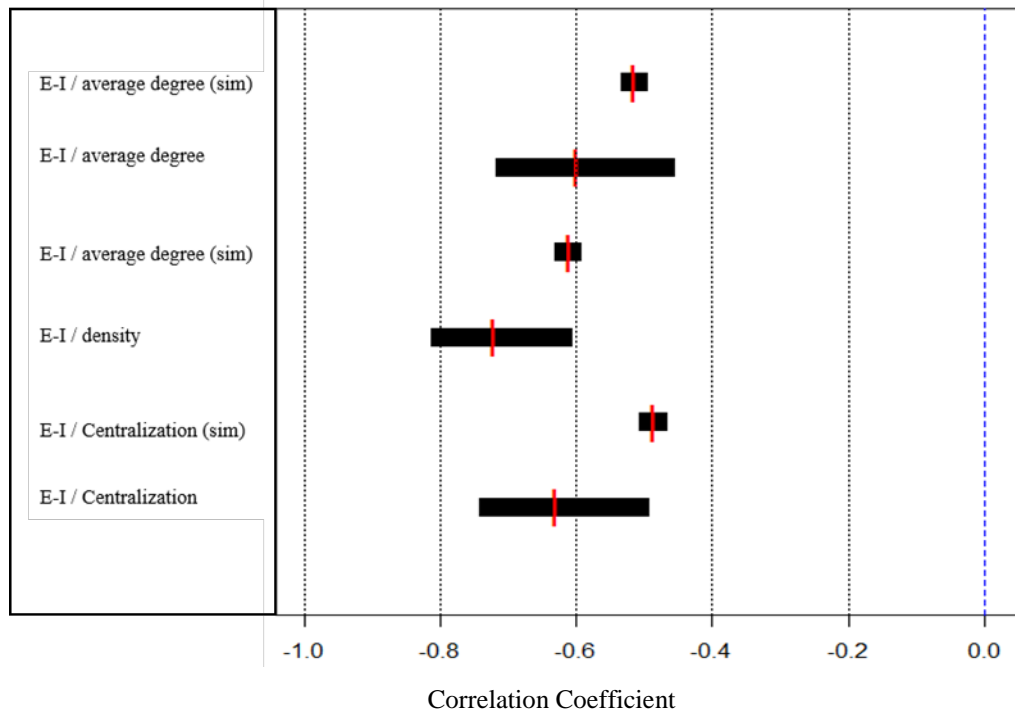


Table 2. Noordin Top Network Pearson's Product Moment Correlation

	Pearson's Product-Moment Correlation 95 Percent Confidence Interval		
	Min	Max	Sample Estimates
Group E-I Index and:			
Average degree (Simulated)	-0.492	-0.483	-0.488**
Average degree (Empirical)	-0.797	-0.623	-0.722**
Density (Simulated)	-0.615	-0.608	-0.612**
Density (Empirical)	-0.797	-0.623	-0.722**
Centralization (Simulated)	-0.492	-0.483	-0.488**
Centralization (Empirical)	-0.727	-0.509	-0.630**

** p -Value < 0.0001

C. PROVISIONAL IRISH REPUBLICAN ARMY

Limitations inherent to the PIRA network dataset posed a number of significant challenges to applying the quantitative analysis methods used throughout the previous sections to the PIRA.¹⁰⁵ The most prominent challenges arose from the lengths of the recorded observation intervals and from the limited total number of longitudinal network observations. The network data used in this section aggregates 30 years of relational change in to six four-to five-year interval snapshots. The limited number of observation intervals restricted the statistical rigor that we were able to apply to the data, and the length of the observation interval precluded our ability to capture sub-interval level changes in network structural changes resulting from micro-level network shocks and individual historic events.

Figure 12 and Table 3 depict the same measures evaluated in previous networks¹⁰⁶ for the dark components of the PIRA network. In addition the graph has an added line indicating the mean number of violent attacks conducted by the organization

¹⁰⁵ These limitations are not reflective of any shortcoming in the research methods or data aggregation techniques used by the original researches. Rather they are the byproduct of a dataset not specifically designed for some of the novel analytical approaches employed within this thesis.

¹⁰⁶ Network measures include density, average degree centrality, centralization and group E-I index.

during the same period.¹⁰⁷ Observations span from the year 1969 to 1998. Dotted vertical lines in the graph mark distinct periods of structural variation in the organizations evolution. From left to right the dotted vertical lines represent the periods 1977–1980, 1985–1989, and 1990–1994.

From 1969 to 1980 there is an increase in the number of attacks and the E-I index. During this period, the organization began to coalesce from a loosely connected set of locally oriented cells into a more military-like structure comprised of brigades, battalions, and companies.¹⁰⁸ Original research findings from Gill et al. suggest the network had multiple cores that over the period developed into a hub within the network.¹⁰⁹ The movement became organizationally centralized with assigned geographic areas of responsibility and more defined tasks and roles within the brigades. This allowed for better operational security through secrecy and discipline.¹¹⁰ This phase also saw the development of the political wing, Sinn Féin and a drop in the number of charges filed by the authorities. The decline in charges was likely due in part to the renewed attention to operational secrecy.¹¹¹

Between 1980 and 1989 the group E-I index continues on an upward trend as the average number of attacks per year decreases. This period was marked by an increase in political activity by Sinn Féin accompanied by a focus on non-violent tactics such as protests and hunger strikes. These garnered much more public support and may have led to some PIRA members being elected into local political positions. Of note PIRA member Bobby Sands was actually elected while conducting a hunger strike.¹¹² These two factors contribute to explaining both the increases in embeddedness and the reduction in attacks.

¹⁰⁷ Violent attack data was taken from the Global terrorism database and includes armed assaults, assassinations, facility/infrastructure attacks, and, bombings/explosions.

¹⁰⁸ Paul Gill, et al., “Lethal Connections: The Determinants of Network Connections in the Provisional Irish Republican Army, 1970–1998,” 65.

¹⁰⁹ Ibid.

¹¹⁰ Ibid., 55–56, 65–66.

¹¹¹ Ibid.

¹¹² Ibid., 56–68.

From 1989 to 1994 attacks increase sharply accompanied by a sharp increase in the E-I index. During this period negotiations were ongoing between the violent arm of PIRA and the government, with Sinn Féin gaining more credibility in the political realm.¹¹³ From 1994 through 1998 a sharp drop in attacks was accompanied by a slight decrease in E-I index. During this period the movement tended to be more inclined to make connections outside of the brigade in which a member belonged. Negotiations lead to an official cease-fire and finally the Good Friday agreement, the 1998 accord between the British government and PIRA.¹¹⁴

Throughout the network lifecycle, centralization remained relatively stable throughout with the exception of a slight increase in the last period. Simulated centralization scores are nearly indistinguishable from empirical values across all periods. Additionally, there were no notable fluctuations in the provincial cosmopolitan measures for the network, with the possible exception of a dip leading into the 1990s. Visual analysis of the PIRA network suggests that both the empirical and simulated E-I index are generally positively correlated with the number of attacks. While the number of data points is insufficient to allow any firm conclusions, it is possible that higher levels of popular support and participation in the movement allowed the organization to conduct more attacks with a relative degree of impunity. However, this theory by itself is insufficient to explain the drop in attacks between 1980 and 1990 (periods three and five in Figure 12).

113 Paul Gill, et al., "Lethal Connections: The Determinants of Network Connections in the Provisional Irish Republican Army, 1970–1998," 70.

114 Kathryn Gregory, Provisional Irish Republican Army (IRA) (aka, PIRA, "the provos," Óglaigh na hÉireann) (UK separatists), Council on Foreign Relations, Mar 16, 2010, <http://www.cfr.org/separatist-terrorism/provisional-irish-republican-army-ira-aka-pira-provos-oglaigh-na-heireann-uk-separatists/p9240>.

Figure 12. PIRA Network Statistics

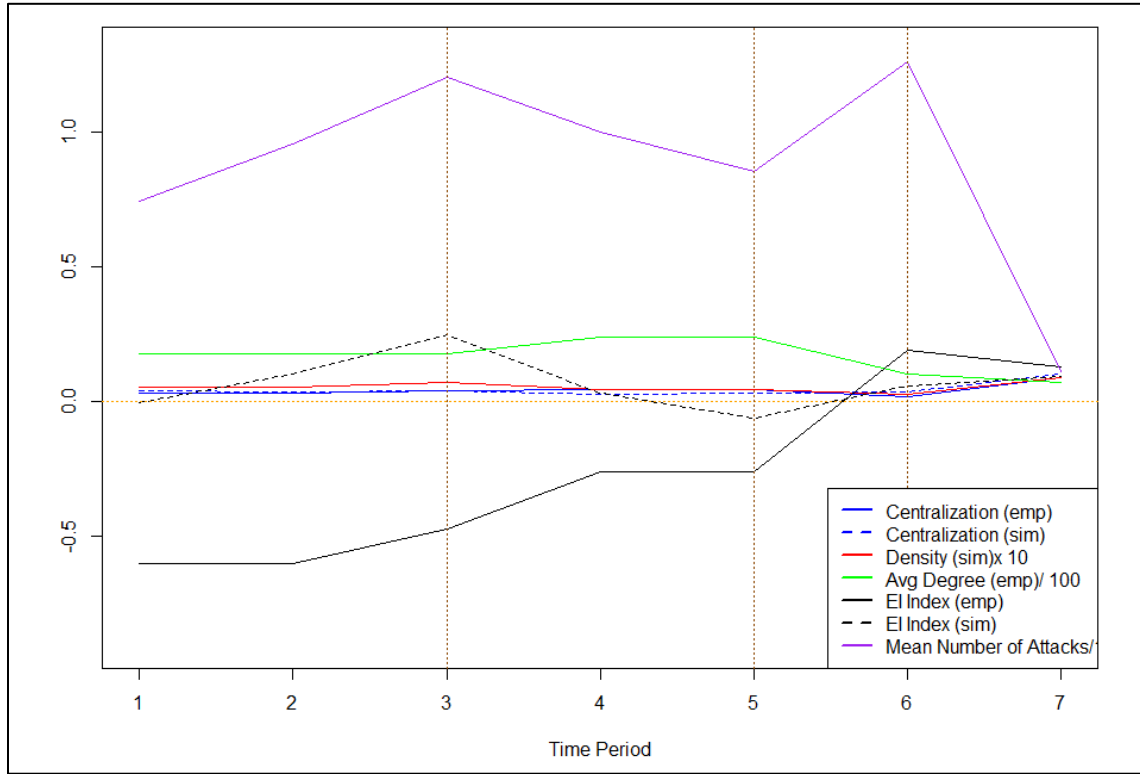


Table 3. Empirical PIRA Network Values

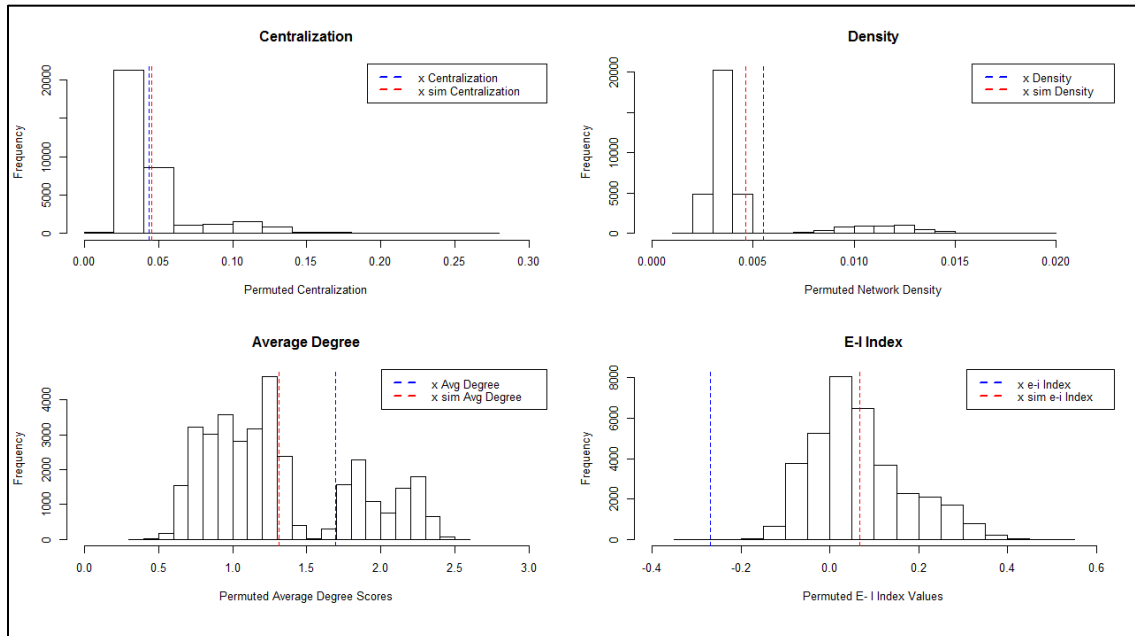
PIRA Network Values					
Year	Density	Avgdegree	Centralization	Group EI	Attacks*
1969-1972	0.005	1.789	0.031	-0.6	74.3
1973-1976	0.005	1.789	0.031	-0.6	95.8
1977-1980	0.007	1.771	0.041	-0.474	120.5
1981-1984	0.005	2.392	0.045	-0.262	100
1985-1989	0.005	2.392	0.045	-0.262	85.6
1990-1994	0.003	1.011	0.019	0.191	126.2
1995-1998	0.009	0.723	0.091	0.13	11

*Average number of annual attacks

1. PIRA Network Statistics Summary

Figure 13 depicts the simulated distribution and empirical mean of each of the evaluated network measures. The distribution of permuted network scores suggests that on average, a random network sharing the same number of ties, nodes and attributes as the PIRA network would tend to manifest as relatively positively embedded, more densely connected, and centralized albeit only slightly. As in previous networks, the mean empirical value for centralization falls near the average and peak distribution value observed within the permuted networks. From a provincial-cosmopolitan perspective the dark components of the empirical network manifests as being slightly more connected than their permuted counterparts averaging 0.4 fewer ties.¹¹⁵ From an embeddedness perspective, the PIRA network is significantly less embedded and is much more insulated (internally connected) than a randomly generated network. Of note, substantial changes in network structure in the later periods result in skewed distributions for centralization and density as well as a bi-modal distribution for average degree.

Figure 13. PIRA Network Measure Distribution Summary



PIRA Dark Network Partition (35,000 Permutations)

¹¹⁵ The multimodal degree distribution depicted in the graph is most likely the result of the significant variation in PIRA network size across the observation intervals.

2. PIRA Correlational Analysis

As depicted in Figure 14 and Table 4 empirical PIRA data found no statistically significant correlation between E-I index and the empirical measures of density, average degree, and centralization. In the case of average degree and centralization, the lack of statistical significance almost certainly reflects the limited number of empirical observations.¹¹⁶ The magnitude of the negative correlation observed between E-I and average degree shows that embeddedness had a particularly negative effect on PIRA's structural efficiency. However, this observation should be tempered by the fact that the correlation is actual less negative than that of the simulated network. In contrast, the sample estimate for empirical centralization exceeds that of the permuted network in support of the original hypothesis.

In all instances, empirical sample estimates fell to the right of the simulated ones. This is the opposite direction as was observed in the Noordin case, and may suggest that corollary values could be sensitive to underlying differences in network structure. The simulated coefficients for these measures had similar significance as those observed within the FFF and Noordin Top Networks.

¹¹⁶ The P -values for the coefficient of correlation for empirical average degree and centralization were 0.134 and 0.412 respectively. With only six degrees of freedom within the observed data, observing a statistically significant relationship is would have been unlikely in any case. By simply doubling the existing data it is possible to generate p -values of 0.017 and 0.191.

Figure 14. PIRA Correlation Coefficient Confidence Intervals

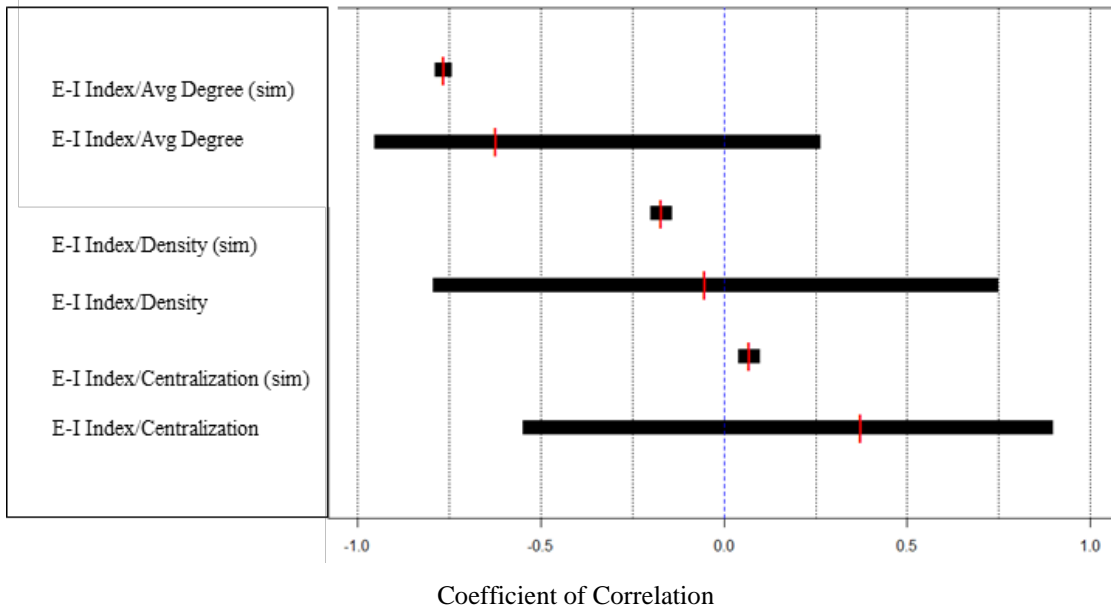


Table 4. PIRA Network Pearson's Product Moment Correlation

Group E-I Index and:	Pearson's Product-Moment Correlation		
	95 Percent Confidence Interval		
Group E-I Index and:	Min	Max	Sample Estimates
Average degree (Simulated)	-0.771	-0.762	-0.767**
Average degree (Empirical)	-0.937	0.242	-0.625
Density (Simulated)	-0.183	-0.163	-0.173**
Density (Empirical)	-0.775	0.730	-0.052
Centralization (Simulated)	0.058	0.079	0.068**
Centralization (Empirical)	-0.530	0.879	0.371

** p -Value < 0.0001.

D. CONCLUSION

This chapter applied a unique statistical approach to rigorously test the structural effects of embeddedness across three dark networks. The results of this analysis do not appear to support the initial hypothesis (that embeddedness leads to structural efficiency) and render varied and inconclusive results. For example, E-I index correlated negatively

with average degree with both the PIRA and Noordin top networks, and positively with average degree in the case of Southeast Asian FFF. In contrast, centralization correlated negatively with both the Noordin and FFF networks and positively in the case of PIRA.

In most instances, coefficients of observed empirical co-relationships were statistically significant, and exceeded those produced by simulated networks. Contextual evaluation of these results suggests that unevaluated endogenous and exogenous factors may have exerted prevailing influences on network structure. Chapter VI will combine social movement theory (SMT) with standard SNA graphs and measures to attempt to illuminate and unpack the relevant meta-networks and micro level processes in play.

VI. QUALITATIVE ANALYSIS

This chapter will layer social movement theory (SMT) and activity analysis to provide a qualitative social network analysis (SNA) of the Southeast Asian Foreign Fighter Facilitation (FFF) network, the Noordin Top Terrorist network, and the Provisional Irish Republican Army (PIRA) network. This chapter is divided into three sections, each focused on one of the three empirical networks respectively. Each section will include contextual network overview followed by analysis. Analysis will use temporal and social network graphs, in addition to narrative descriptions in order to examine the evolution of meta-network membership and structure, individual mobilization, and embedding processes, as they relate to bright external network connections.

A. SOUTHEAST ASIAN FOREIGN FIGHTERS

The current Syrian and Iraqi crisis have created a beacon for foreign fighters and facilitators with a desire to fight against the Assad regime or to fight alongside the self-styled Islamic State known as Islamic State of Iraq and the Levant (ISIL). These fighters pose a threat not only to the long-term stability of Iraq and Syria, but also to the stability of their home countries. History has demonstrated that foreign fighters often return home radicalized and go on to lead or participate in domestic terrorism campaigns. The founding members of Indonesian based Jemaah Islamiyah (JI) the Abu Sayyaf Group (ASG)¹¹⁷ the Kumpulan Mujahidin Malaysia (KMM)¹¹⁸ and Lashkar Jihad ¹¹⁹ all fought as mujahidin in Afghanistan before establishing their own violent extremist

¹¹⁷ The ASG is a violent extremist group founded in 1991 by Filipino, Abdurajak Janjalani. Its primary goal is creating an independent Islamic state in areas of Mindanao (Australian National Security, <https://www.nationalsecurity.gov.au/Listedterroristorganisations/Pages/AbuSayyafGroup.aspx>).

¹¹⁸ The KMM founded by an Afghan mujahid in 1995. Its goals are to topple the Mahathir government and create an Islamic state that includes Malaysia, Indonesia, and the southern Philippines (FAS Intelligence Resource Program, <http://fas.org/irp/world/para/kmm.htm>).

¹¹⁹ Lashkar Jihad or Laskar Jihad was founded by Jafar Umar Thalib in 2000. It is an Islamist, anti-Christian, militia based in Indonesia that grew out of clashes between Christians and Muslims in 1999 (Terrorism Resource Analysis Consortium, <http://www.trackingterrorism.org/group/lashkar-jihad-indonesia>).

organizations.¹²⁰ This section will explore the multiplex network structures with Southeast Asian foreign fighter networks with an emphasis on the role of bright ties, centralization, and embeddedness.

Analysis of the Southeast Asian FFF network is divided into three parts. Each part approaches the network from a different perspective. Part one provides an historical overview of FFF and jihad's roots in Southeast Asia. Part two builds upon part one by using SMT to describe organizational networks and established embedded ties which have enabled foreign fighter mobilization; it also provides narrative examples highlighting the evolving role of Southeast Asia as a hub for itinerant mujahedeen. Part three uses longitudinal SNA graphs to describe the evolution of Southeast Asian FFF networks between 1980 and 2015 at both organizational and individual levels using cross organizational relationships divided into five to eleven year snapshots highlighting noteworthy periods of mobilization.¹²¹

1. Profiles of Foreign Fighter Facilitation: Microstructures and Relational Ties

The following analysis examines the implications of embeddedness on foreign fighter recruitment and mobilization through the lens of social movement theory. It studies individuals within, and relationships between, three prominent network varieties: latent and vestigial FFF networks, sociopolitical networks, and criminal and prison networks. Links between individuals, the Maktab al Khidmat lil-Mujaheddin al-Arab (MAK), Al Qaeda, and various jihadi groups currently operating in Syria and Iraq are examined as examples or proofs of how dark, bright, and shady networks can contribute towards radicalization, foreign fighter recruitment and facilitation.

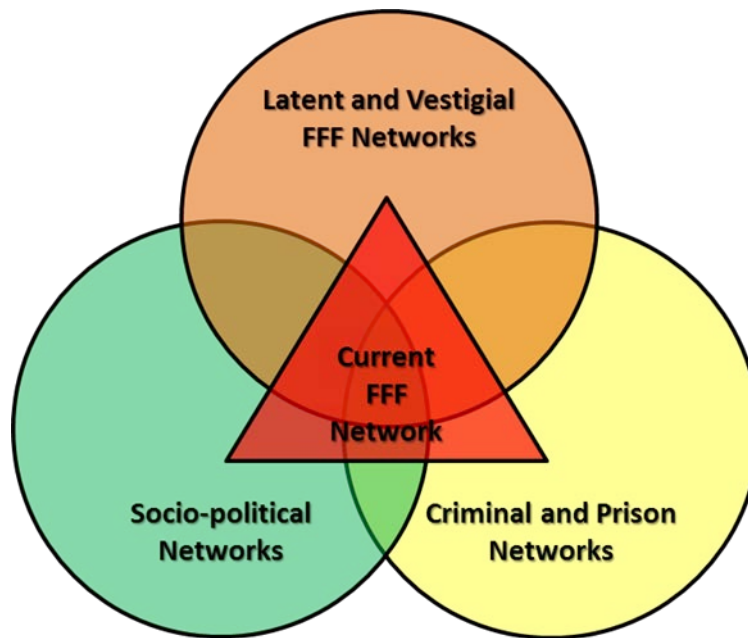
Research by McAdam and Snow et al. demonstrates that among individuals profiled, integration into multiple organizational networks, links to activists, and a history

¹²⁰ Zachary Abuza, "Tentacles of Terror: Al Qaeda's Southeast Asian Network." *Contemporary Southeast Asia* 24, no. 3 (2002): 428.

¹²¹ The periods surveyed throughout this section include: Jihad against the Soviet occupation of Afghanistan (1981 - 1990), the rise of al Qaeda (1991 -2000), U.S. entry into Iraq and Afghanistan (2001-2010), and the rise of DAESH (2011 – 2015).

of activism served as the strongest predictors of participation in high-risk activist activity. Their results point to the importance of interpersonal ties and kinship ties between movement members in determining recruitment potential.¹²² This subsection will provide a qualitative examination of McAdam's and Snow et al.'s theories. Figure 15 represents a graphical depiction of the relational network linkages previously described.

Figure 15. Conceptual FFF Network Model



a. Integration into Networks

FFF participation is influenced through a variety of sources. The following paragraphs provide examples of how kinship, associational networks, and personal histories of activism have contributed to and may serve as predictors for FFF participation.

¹²² Doug McAdam, "High-Risk Activism: The Case of Freedom Summer," 64–90; David A. Snow., Louis A. Zurcher Jr., and Sheldon Ekland-Olson, "Social Networks and Social Movements: A Microstructural Approach to Differential Recruitment," 787–801.

b. Kinship

The families of JI members Muklahs and Samudra provide an exceptional example of extremists whose participation in violent activity was heavily linked through kinship ties. The primary conspirators of the 2002 Bali bomb attack, which killed 202 people, were Imam Samudra, Muklahs, Ali Imron, and Amrozi. Of these four individuals, three were brothers (Muklahs, Imron, and Amrozi).¹²³ Now, 13 years later media reports indicate that the sons of both Muklahs (Zaid) and Samudra (Umar Jundul Haq) have traveled to Syria to join Jabhat al-Nusrah.¹²⁴ In this particular case close kinship ties to extremists appears to have played a significant role in motivating all four associated family members to extremist activity. Similar scenarios are common among Southeast Asian extremists. Abdulrajak Janjalani, who founded the ASG, was replaced after his death by his brother, Khadaffy Janjalani. This list of extremists whose family members also participated in activist or violent behavior goes on and on.

c. Associational Networks

Not all ties to radicalism in Southeast Asia are familial. There are numerous examples in which associational networks have been important in recruitment to participation in FFF. McAdam describes two ways in which associational networks can facilitate recruitment namely individual and “bloc recruitment.” McAdam references Anthony Oberschall in describing bloc recruitment a mechanism in which groups of individuals are recruited at once though the cooption of established associations or organizations.¹²⁵ Of the extremist organizations currently operating in Syria and Iraq, ISIS has been the most successful in gaining pledges of support from existing Southeast Asian groups. Currently at least three major groups have pledged their support including

¹²³ Maria Ressa, *Seeds of Terror: An Eyewitness Account of Al-Qaeda's Newest Center of Operations in Southeast Asia*.

¹²⁴ Deborah Cassrels, “Bali Bombers’ Sons among Next Generation of Indonesia Terrorists,” *The Australian*, 30 May 2015, <http://www.theaustralian.com.au/news/inquirer/bali-bombers-sons-among-next-generation-of-indonesia-terrorists/story-e6frg6z6-1227375132500>.

¹²⁵ McAdam Doug, “High-Risk Activism: The Case of Freedom Summer,” (July, 1986).

the ASG, Jemaah Ansharut Tauhid (JAT), Bangsamoro Freedom Fighters (BIFF).¹²⁶ Current ISIS block recruitment in Southeast Asia has been limited to dark organizations, though bright and shady networks such as Forum Anak Kost Se-Indonesia (FAKSI) an activist Islamic advocacy group have made open pledges of support. However, at this point it remains unclear how many members from these groups have or will actually travel to fight in Syria.

Associational network affiliation also facilitates individual recruitment. While this method is not nearly as efficient as bloc recruitment, it remains an effective source of mobilization. Among the network varieties described earlier sociopolitical organizations and prison networks appear to be two common recruitment avenues for aspiring foreign fighters in Southeast Asia.

Pondoks and Pesantrens (Southeast Asian religious boarding schools similar to madrasas) have long played an important role in FFF recruitment. The notorious Al Mumkin Pesantren in Ngruki provided fighters to the MAK dating back as long ago as the early 1980s. This same organization also produced many leaders within JI and the Noordin Top terrorist network. Organizations like the Al Mumkin Pesantren have proved difficult to regulate in part because they are viewed as important institutions within the community and in part because of their ability to maintain a certain plausible deniability. The Al Mumkin Pesantren continues to operate within Indonesia and has recently been linked to foreign fighters in Syria.¹²⁷

The International Crisis Group (ICG) provides an example of a contemporary Al Mumkin nexus in Ari Budi Santoso. This Al Mumkin alumnus and associate of ex-Noordin group member Joko Pitono provided shelter to Ali Miftah (an escapee of the 2010 Aceh camp raid) and facilitated the transportation of material for a series of failed bombing attempts in Sirebon. Prior to his arrest in 2011, Ari Budi Santoso occupied an

¹²⁶ James Brandon, "Syrian Recruitment and Iraqi Jihads Prompt Increased Recruitment and Activism in Southeast Asia," *Combating Terrorism Center Sentinel*, 7 no. 10, (October 2014), 17–20.

¹²⁷ Solahudin, "Syria as Armageddon," *Inside Indonesia*, Accessed on 15 September 2015. <http://www.insideindonesia.org/syria-as-armageddon>.

ostensibly bright position in Indonesian society working as a kindergarten teacher, herbal treatments salesman, and mosque youth group advisor.¹²⁸

Prison networks provide a unique environment for foreign fighter recruitment. While serving their sentences hard-core jihadists and terrorists mix with petty criminals and thugs. Individuals form tactical alliances for survival and better treatment. According to an IPAC report, terrorist organizations routinely send care packages to imprisoned members, which allow them to gain significant influence over the prisoners.¹²⁹ Due to inadequate security measures, prisons also provide a venue for individuals across all three entity categories (dark, bright, and shady) to freely associate and propagate extremist ideology.

Julie Hwang describes an incident involving an inmate by the name of Rois a staunch ISIS supporter who was sentenced to death row for his participation in the Australian embassy bombing and Sam, a Ring Banten member who had been convicted for robbery in support of the Bali bombing. After serving his initial sentence, Sam visited Rois in prison and shortly afterward left to fight in Syria.¹³⁰ In a separate incident described in an IPAC report Rois recruited another Bali bomber (Abdul Rauf) to fight for ISIS.

Abdul Rauf, released in 2011 after serving more than eight years for his role in the Bali bombing, was a model prisoner and by all accounts remorseful and convinced that violence against civilians in Indonesia was wrong. When he was brought into the Bali bombing by Imam Samudra, he believed he was going to be sent to Ambon to fight. When he was released, he was a regular visitor to Nusakambangan to visit Rois and on one occasion expressed a desire to fight in Myanmar to avenge violence against Muslims

¹²⁸ “Indonesia: How Extremists Regroup,” *ICG Asia Report* 228 (July 2012), i.

¹²⁹ Institute for Policy Analysis of Conflict, “Support for “Islamic State” in Indonesian Prisons,” IPAC Report no. 15, 19 January 2015.

¹³⁰ Julie C. Hwang, and Noor Huda Ismail, “There and Back Again: Indonesian Fighters in Syria,” *Middle East Institute*, 27 January 2015.

there. Rois told him how he could get to Syria instead. Abdul Rauf left in early 2014 and was killed in May 2014 in Ramadi, Iraq.¹³¹

d. History of Activism

As noted above McAdam's third predictor of high-risk activism is a history of activism. This characteristic appears to hold true for each of the foundational leaders of the original Participation in the Afghan jihad proved to be an important predictor of future participation in domestic extremist activity."¹³² The importance of past activism as a mechanism is evident in the backgrounds of the founding members of JI, ASG, as well as in the cases of more recent Southeast Asian Mujahedeen. Abu Bakar Bashir, and Abdullah Sungkar, the two founding members of JI, got their start in activism through their affiliation with the activist missionary group Dewan Dakwah Islamiyah Indonesia (DDII).¹³³ And Abdulrajak Janjalani, founder of ASG, got his start as a member of Moro National Liberation Front (MNLF) before traveling to Afghanistan, and then setting up his own violent extremist organization.¹³⁴ More recently, individuals such as Salim Mubarak an Islamic activist from FAKSI also transitioned from domestic activism to foreign jihad.¹³⁵

2. Organizational Networks and Ties

This section will incorporate Gould's methodology to dark network analysis by including both "bright" and dark nodes and relationships to explore the historic pathways to radicalization which has facilitated foreign fighter mobilization in Southeast Asia over

¹³¹ Institute for Policy Analysis of Conflict, "Support for "Islamic State" in Indonesian Prisons," *IPAC Report* no. 15, 19 January 2015, 17.

¹³² Max, Gross, "A Muslim Archipelago," (Washington, DC: National Defense Intelligence College, 2007), 52.

¹³³ Martin van Bruinessen, "Genealogies of Islamic radicalism in post-Suharto Indonesia," *Southeast Asia Research*, 10, no.2 (2002) 117–154.

¹³⁴ Zachary "Abuza, Balik-Terroism: the Return of Abu Sayyaf." The Strategic Studies Institute, September 2005.

¹³⁵ Institute for Policy Analysis of Conflict, "Evolution of ISIS," *IPAC Report* no. 13, 24 September 2014.

the past 35 years emphasizing the role played by bright entities and embeddedness.¹³⁶ The following graphs evaluate links across five relationships including alliances, collaboration, overlapping membership, finance, training, foreign fighter transfer, and miscellaneous. This report will divide FFF into four distinct operational periods in order to illustrate the growth and evolution of the networks involved. Periods were selected in an attempt to capture network evolution in conjunction with relevant and significant world events. The periods evaluated are as follows: Southeast Asian mujahedeen fight the Soviet occupation of Afghanistan (1981–1990), the rise of al Qaeda (1991–2000), U.S. entry into Iraq and Afghanistan (2001–2010), and the rise of Islamic State of Iraq and the Levant (ISIL) (2011–015).

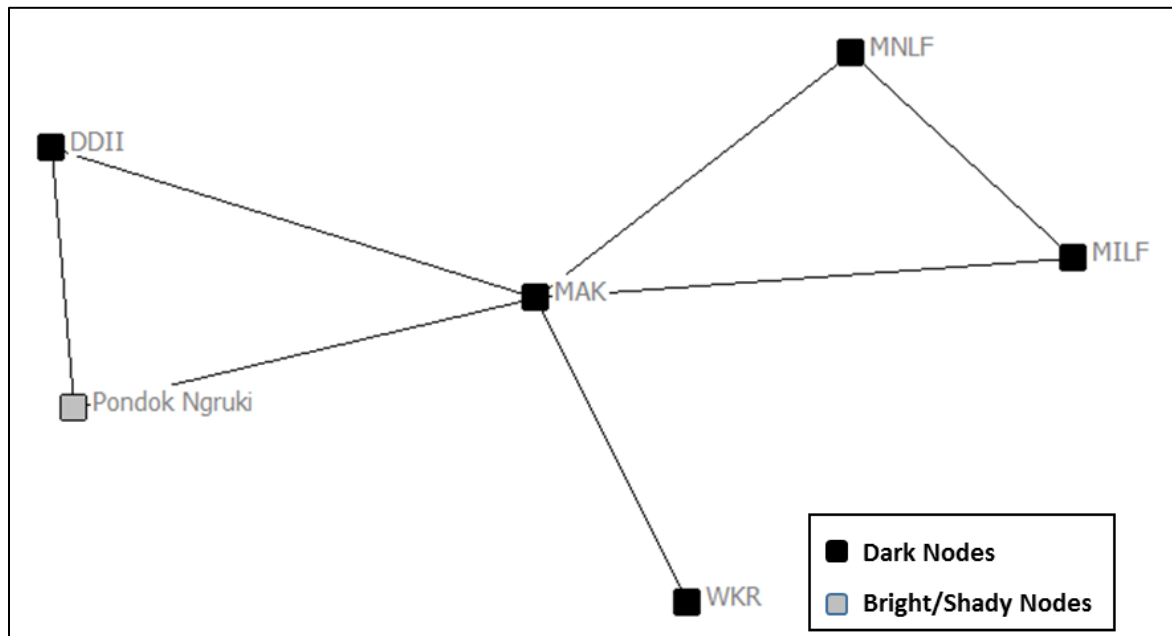
a. 1981 through 1990: Jihad against the Soviet Occupation of Afghanistan

The MAK network foreign fighter recruiter network represents Southeast Asia's first foray into the foreign Arena. Initial coordination to send participants to Afghanistan came from individuals who were already participating in domestic activism. A key regional contact, Hashim Salamat was an ex-MNLF member and founder of the Moro Islamic Liberation Front (MILF). The MAK also received support from Abu Bakar Bashir and Abdullah Sungkar (Darul Islam Activists from Indonesia).¹³⁷ Through those initial contacts, the MAK established a foothold in Southeast Asia that would grow over time. Figure 16 depicts the initial Southeast Asian FFF network as it appeared between 1980 and 1991. During this period Pondok Ngruki, a religious boarding school in Indonesia, is the only observed bright node within the MAK network.

¹³⁶ In the context of this essay the term bright is used to refer to entities, organizations, or linkages that are overt or legal: essentially the opposite of the term dark as coined by Milward and Raab.

¹³⁷ Maria Ressa, *Seeds of terror: An eyewitness account of Al-Qaeda's newest center of operations in Southeast Asia*, (New York: Free Press, 2003); Zachary Abuza, *Militant Islam in Southeast Asia: crucible of terror*, (Boulder, CO, USA, Lynne Rienner Publishers, 2003).

Figure 16. Southeast Asian FFF Network 1980–1990



6 nodes (1 bright/shady) 7 links

b. 1991 through 2000: The Rise of al Qaeda

Figure 17 depicts the Southeast Asian FFF networks between the Soviet occupation of Afghanistan in the 1980s and the American occupation of Afghanistan beginning in 2001. During this period, they remained active. Motivated by Usama Bin Laden's far enemy paradigm, members of the Southeast Asian network continued to target occidental symbols within the region. Although the scale of violence during this period are generally more consistent with domestic terrorism or low scale insurgency,¹³⁸ an international cadre of trainers, coordinators, and fighters allow these networks in aggregate to continue to meet the definition of foreign fighters. This is especially true in cases where targets crossed territorial boundaries. Returned fighters formed ASG, JI, and KMM. These groups along with the MAK (now rebranded as al-Qaeda) begin to expand connections to bright entities. JI and the newly founded KMM establish connections with the Pan-Malaysian Islamic Party (PAS). Al-Qaeda and ASG work together through Mohammed Jamal Khalifa to establish a branch of the International Islamic Relief

¹³⁸ Unlike the foreign fighters who participated in the conflicts in Afghanistan, Bosnia, Syria and Iraq, by and large violence in Southeast Asia did not rise to the level of an active war zone.

Organization in the Philippines.¹³⁹ According to Ressa the Philippine IIRO branch served as an important source of funding and recruitment for both ASG and the MILF.¹⁴⁰ The ASG, al Qaeda association, is one of the explanations provided for the increase in Philippine¹⁴¹ terror activities between 1994 and 2001.

Ressa cites a classified Philippine intelligence document, which asserts that the International Islamic Relief Organization (IIRO) was able to garner funds from a network of other “innocent-sounding groups,” including the Islamic Worldwide Mission, Inc. (IWM); Islamic Studies Call and Guidance of the Philippines (ISCGP), Inc.; United Overseas Bangsamoro (UOB); and JMB Personnel Management Services, Inc. (JMBPMS).¹⁴² Meanwhile, JI and Al-Qaeda worked to set up a second pondok in Malaysia (the Lukmanul Hakim).¹⁴³ During this period, off-shoot groups continued to grow and new groups began to establish formalized ties through the coordination of the al Qaeda in Southeast Asia (AQSEA) umbrella.¹⁴⁴ Groups and geographic areas and within the AQSEA network began to provide specialized capabilities for other group members. For example, the MILF, the ASG, and the Philippines served largely as a training and staging area, where Malaysia served as a “back office” and Singapore as a financial hub.¹⁴⁵ Figure 17 depicts the evolution of these relationships.

¹³⁹ Maria Ressa, *Seeds of terror: An eyewitness account of Al-Qaeda's newest center of operations in Southeast Asia*.

¹⁴⁰ Ibid., 108, 131.

¹⁴¹ Ibid., 108.

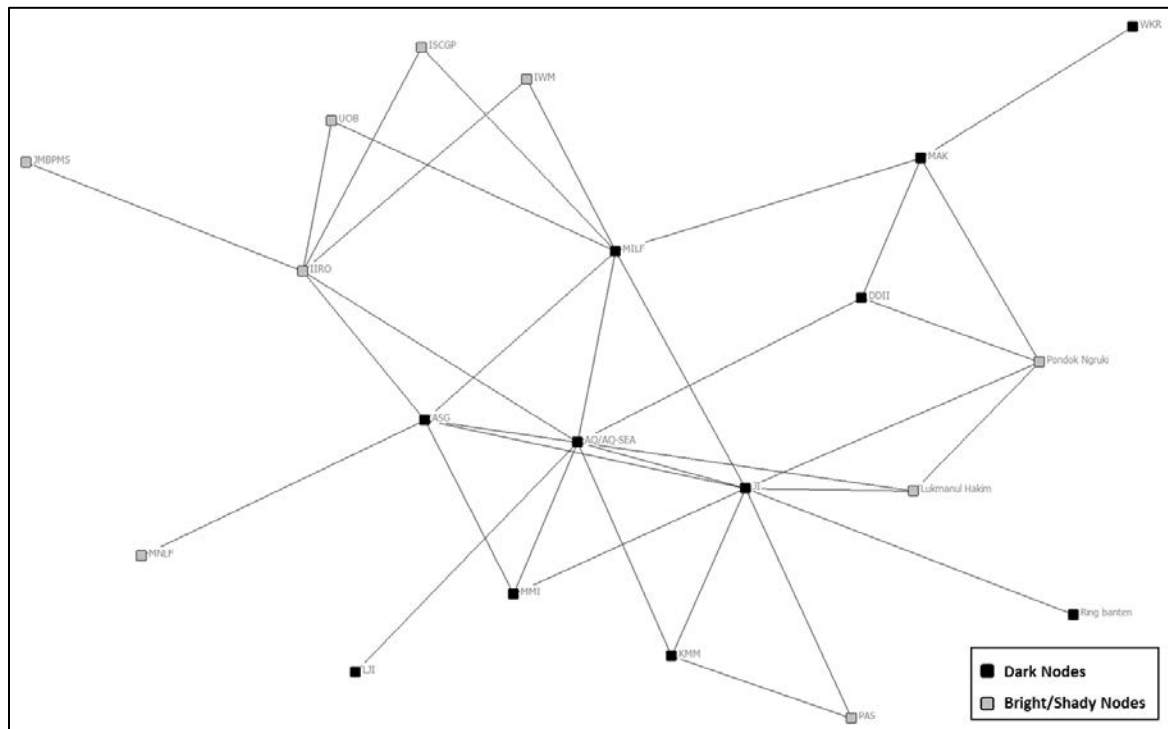
¹⁴² Khalifa selected management of the IWM, and at least one stockholder maintained constant communication with the MILF. The ISCGP worked to recruit fighters and was also connected to the MILF. The UOB served as an international fundraising arm to the MILF with offices Saudi Arabia and Malaysia. JMBPMS was a manpower company which recruited Filipino overseas workers for Saudi Arabia and is linked through a shareholder to a suspect in a 1977 terrorist plot in Manila (Ibid., 131.)

¹⁴³ Ibid.

¹⁴⁴ Zachary Abuza, *Militant Islam in Southeast Asia: Crucible of Terror*. Lynne Rienner Publishers, 2003.

¹⁴⁵ Ibid. 10.

Figure 17. FFF Network 1991 through 2000: The Rise of al Qaeda



c. 2001 through 2010: U.S. Conflict in Iraq and Afghanistan

During the period between 2001 and 2010, organizational growth seemed to have slowed within the network. Pressure from internal security forces and the United States limited AQSEA's operations. The new groups that emerged during this period are mostly the consequence of splintering resulting from ideological difference between moderates and radicals within existing organizations. Most groups continue to focus primarily on domestic issues although intermittent media reports suggest a very limited flow of fighters and personnel between Southeast Asia and the newly formed Al Qaeda in Iraq (AQI). These relationships are depicted in Figure 18.

Legend:

- Dark Nodes (Black Square)
- Bright/Shady Nodes (Gray Square)

d. 2011 through 2015: The Rise of ISIL

146 Some of the statistics pertaining to individual membership growth may be attributed to increases in the availability of data. However, data availability alone does not account for the sheer number of organizations involved in FFF.

HASI was recently listed as an Al Qaeda associated entity by the United Nations Al Qaeda Sanctions Committee.¹⁴⁷ Huang describes HASI as one of four primary jihadi routes used between Indonesia and Syria. HASI presents itself as a humanitarian organization and has used its presence in Syria to facilitate the movement of fighters and support personnel who have gone on to participate in and facilitate foreign fighter activity in Syria and Iraq.¹⁴⁸ HASI is closely linked to JI. Wiji Joko Santoso a HASI leader is also known to be the Head of JI's foreign affairs division.¹⁴⁹ FAKSI, the activist Islamic advocacy group, actively encourages Indonesians to support ISIS and has ties to JAT. The 2011 to 2015 network is depicted in Figure 19.

147 United Nations Security Council, QDe.147. Hilal Ahmar Society Indonesia (HASI), 13, March 2015, <http://www.un.org/sc/committees/1267/NSQDe147E.shtml>.

148 Julie C. Hwang, and Noor Huda Ismail, "There and Back Again: Indonesian Fighters in Syria," Middle East Institute, 27 January 2015.

149 U.S. Department of the Treasury, "Treasury Designates Twelve Foreign Terrorist Fighter Facilitators," 24 September 2014, <https://www.treasury.gov/press-center/press-releases/Pages/jl2651.aspx>.

■ Dark Nodes
 □ Bright/Shady Nodes

46 nodes (10 bright/shady) 71 links

Analysis of individual relational ties within the current Southeast Asia FFF network suggests that the historic AQSEA ties remain the strongest and appear to facilitate the widest variety of resources (finance, training, and co-membership). These reinforcing relationships also appear to position the vestigial AQSEA FFF network closer to the Al Nusrah front and on the periphery of current FFF support to ISIS. This section highlights the fluid nature of Southeast Asian FFF networks over the past 36 years. It also demonstrates that existing theories on social movement and activism are highly applicable to understanding the paths that lead to participation in both domestic extremism and foreign jihad.

B. THE NOORDIN TOP NETWORK

This section uses multiplex SNA and SMT to examine the sources of embeddedness and efficiency within the Noordin Top Terrorist Network. Analysis examines the roles played by kinship and associational networks in shaping network structure. Analysis is divided into three parts and covers the origins of the Noordin Top network, meta-network analysis, mobilizing and embedding processes.

1. Noordin Top Meta-Network Analysis

Meta-network contrasts variations in structure and embeddedness between the complete Noordin Top Network and four component meta-networks namely, friendship, kinship, soulmates, and schoolmates. Due to some geographical, temporal and organizational overlap, the Noordin Top Terrorist network will share some structural and membership elements with the Southeast Asian FFF network.

Figure 20 presents a sociogram of the complete Noordin Top network. Dark nodes are depicted as red while bright and shady nodes are depicted as blue. An initial visual analysis of this network reveals that bright nodes are distributed throughout the entire network generally occupying peripheral positions relative to dark nodes. Bright nodes also appear less connected than their dark counterparts. This observation parallels Morselli's analysis of non-traffickers (bright and shady entities) in an illicit Canadian hashish and cocaine trafficking network.¹⁵⁰ Morselli describes legitimate actors within criminal networks as providing "complementary resources," as well as expertise.¹⁵¹ For the Noordin Top network, bright elements contributed to network efficiency by allowing certain network operations to take place in the public sphere without scrutiny from law enforcement. In one example, Sardona Siliwangi, an Ngruki alumnus, was used to open a bank account to support Noordin's financial transactions. In other instances, bright

¹⁵⁰ Carlo Morselli, "Legitimate Strengths in Criminal Networks," *Inside Criminal Networks*, ed. (New York, Springer, 2009).

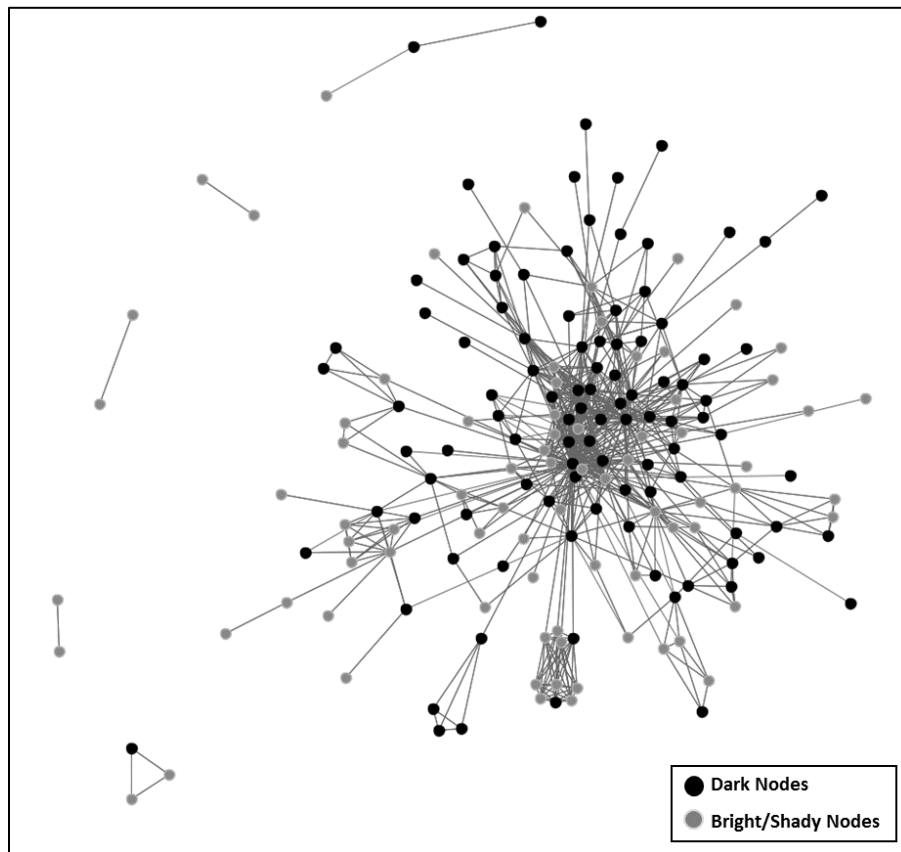
¹⁵¹ Ibid.

members facilitated the transportation of material and provided shelter to fugitive members of the group.¹⁵²

From an embeddedness perspective, Noordin's network enjoyed considerable support from bright and shady entities in total 109 of the 237 member network participated in roles that ostensibly preserved their status as law abiding members of the community. The overall network level E-I index value for the network was -0.109. The dark segment of the Noordin Network represents an organization dominated by internal connections with a group E-I index score of -0.311. Conversely, the bright and shady segments of Noordin's network are connected predominantly through external ties with a group E-I score of 0.259. The disparity in connectedness between dark and bright/shady nodes within the network suggests that on average bright nodes occupied structurally less important positions than their dark counterparts and likely wielded less informal power within the network.

¹⁵² International Crisis Group, "Terror in Indonesia: Noordin's Networks."

Figure 20. Noordin Complete Network



237 Nodes (108 bright/shady) and 1,301 links (isolates removed)

Table 5 provides additional network statistics characterizing the statistical variations between dark and bright nodes within the Noordin network. As depicted in Figure 20, a summary of individual node level measures demonstrates that the Noordin's dark members were more than 50 percent more connected than their bright and shady counterparts with an average of 12.4 connections each compared to 8.1 for bright nodes. Dark nodes also had higher clique counts indicating a greater potential for cross cluster membership.

Table 5. SNA Metrics: Aggregated Noordin Top Network

	<i>Centralization</i>		<i>Betweenness</i>		<i>Clique Count</i>		<i>Clustering Coefficient</i>	
	<i>Dark</i>	<i>Bright</i>	<i>Dark</i>	<i>Bright</i>	<i>Dark</i>	<i>Bright</i>	<i>Dark</i>	<i>Bright</i>
Mean	12.4	8.1	0.0045	0.0017	5.3	3.0	0.5030	0.4605
Std Dev	14.3	10.4	0.0166	0.0047	11.0	6.1	0.3942	0.4279
Range	92	47	0.0315	0.0315	74	31	1	1
Minimum	0	0	0	0	0	0	0	0
Maximum	92	47	0.1678	0.0315	74	31	1	1

a. Family Ties

Figure 21 depicts Noordin Top Kinship meta-network. It includes ties of blood relation and marriage. Overall, this network is characterized by disparate two to five node familial clusters-most containing both bright and dark entities. Compared to the other networks evaluated, the kinship network has the highest percentage of bright/shady membership (55 percent). This meta-network is highly fragmented, decentralized, and cosmopolitan. These characteristics may be common among familial networks, given that individual kinship groups tend to be linked internally and that such linkages do not automatically imply intergroup association with the larger network. This phenomenon would be sensitive to variations in cultural marriage norms, or in cases of small isolated populations.

Within the larger Noordin Top network, familial ties provided a network whose members were bound by implicit trust and redundant connections to the local community. Family members and their internetwork relationships constitute a minority within the Noordin network's composition. Members of Noordin's kinship meta-network account for 34 percent (80 of the 237 nodes), and 15 percent of the total relationships (192 of 1301 ties). In spite of occupying minority a position, Members of Noordin's kinship network contributed disproportionately to the ranks of facilitators and sympathizers providing 92 percent of known sympathizers (11 of 12) and 25 percent of facilitators (11 of 44). In many cases, family members provided subtle, albeit essential enabling roles.

Figure 21. Noordin Top Kinship Meta-Network



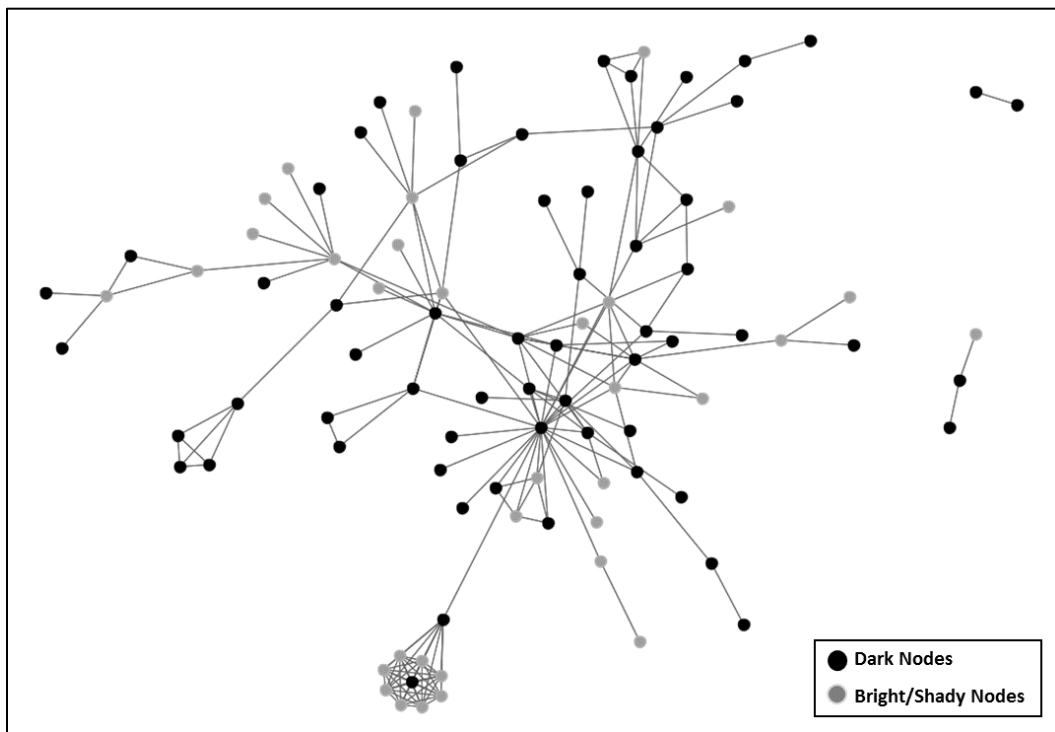
80 nodes (44 bright/shady) 192 links (isolates removed)

b. Freindship Ties

Friendship ties within the Noordin Network represent affective relationships between members exclusive of kinship ties. Figure 22 depicts the friendship meta-network. Independently this network accounts for 41 percent (98 of 237) of total nodes and 27 percent of the total relationships (354 of 1301 ties) within the complete network. In spite of being the largest meta-network studied in this section it is also the most cohesive network with the lowest fragmentation score. Unlike familial ties, Noordin's friendship ties follow a power law distribution suggesting that link formation may be influenced by a preferential attachment process.

According to Mark Granovetter, even weak friendship ties can enable knowledge sharing between individuals by providing access to new information and resources through crosscutting connections.¹⁵³ In the case of the Noordin Network friendship ties play an important role in connecting otherwise separated network entities. Members of the friendship network constituted the backbone of Noordin's organization. All of the network's leaders, recruiters, and trainers were part of the friendship network as were 11 of the network's 12 strategists. Among bright and shady members, of the friendship meta-network 60 percent occupied roles of facilitators or provided support in an unspecified capacity. With others serving in influential positions as local leaders and religious leaders or teachers (all of the religious leaders and teachers within Noordin's friendship network were bright or shady entities). A sociogram of Noordin's friendship network shows indications of homophily within bright and dark network categories.

Figure 22. Noordin Friendship Network



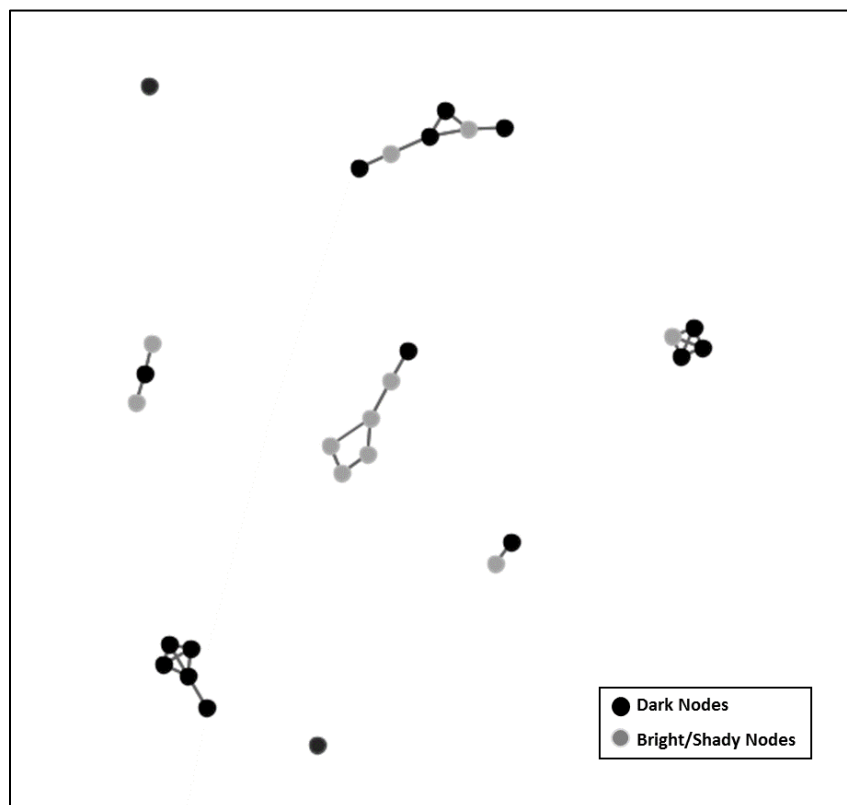
98 nodes (34 bright/shady) 354 links (isolates removed)

¹⁵³ Mark Granovetter, "The strength of weak ties." *American Journal of Sociology* (1973): 1360–1380.

c. Worship Ties

Figure 23 depicts the Noordin Top soulmates network, which includes connections between network members based on attendance at the same religious institution at the same time. Worship ties do not account for religious ties through religious boarding schools; those ties are captured in the schoolmate's meta-network. The soulmates network is the smallest of those examined and comprises only 26 nodes (11 percent) of the overall network. In spite of small relative size, the soulmate members make up a disproportionality high percentage of the network's bomb makers (45%). Bright and shady members of the soulmate meta-network were limited to sympathizer, facilitators or unknown. Structurally the soulmate network is most similar to the kinship network in terms of fragmentation centralization and connectivity.

Figure 23. Noordin Top Soulmates Network

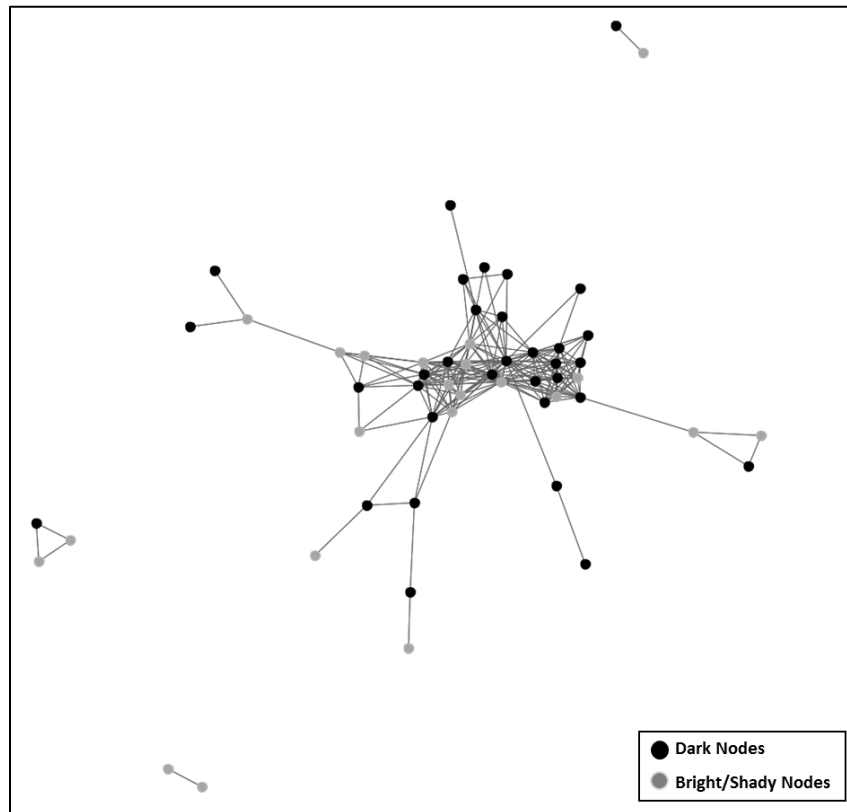


26 nodes (11 bright/shady) 27 links (isolates removed)

d. School Ties

Figure 24 depicts schoolmate ties within the Noordin network. Connections are based on members shared attendance at a particular school during the same time period. Connections within this network are primarily formed by alumni of the Al Mumkin and Lukmanul Hakim pesantrens. Bright and shady nodes make up approximately 40 percent of the membership and occupy relatively central positions within this meta-network. Of the meta-networks evaluated in this section, the schoolmates network is the most centralized and the most connected, with a degree centralization score of 0.42 and an average degree centrality score of 7.9. These scores suggest the potential for embeddedness through certain varieties of sociocultural institutions to aid in contributing towards structural efficiency. This is in contrast to the relationship observed between efficiency and worship ties.

Figure 24. Noordin Top Schoolmates



55 nodes (22 bright) 436 links (isolates removed)

Analysis of the Noordin Top Network demonstrates that the effects of embedded connections vary considerably depending upon the source of embeddedness. In this case, embeddedness based on kinship or simultaneous membership within religious institutions manifests in a network of decentralized cells. In contrast, schoolmate and friendship networks are much more provincial and centralized. Additionally, those networks with larger percentage of bright nodes tended to fall into the two less efficient network structures. This trend highlights a potential constraint on the potential for embeddedness to increase centralization or the provincial-cosmopolitan nature of network structure. Table 6 provides measurements of network centralization, fragmentation, and density as represented by average degree. It also provides values for the percentage of bright/shady nodes as a percentage of total nodes.¹⁵⁴ The contrast in structure observed between schoolmates and soulmates meta-networks may provide an avenue for future research into the varied roles played by embeddedness in sociocultural institutions in shaping network structure.

Table 6. Noordin Top Meta-Network Measure Distribution

	Size	Centralization	Fragmentation	Avg Degree	Pct Bright
Kinship	80	0.07	0.93	1.2	55
Friendship	98	0.22	0.14	3.9	34
Schoolmates	55	0.42	0.24	7.9	40
Soulmates	26	0.08	0.85	1.0	42
Complete	237	0.35	0.50	5.5	46

Note: Meta-network membership is not exclusive and calculations are discrete. Values do not sum to complete network.

¹⁵⁴ Fragmentation scores represent the percentage of nodes within a network that are disconnected from one another. Possible fragmentation scores range between 0 and 1 with 1 representing a network in which all nodes are disconnected and 0 representing a network in which all nodes are connected. (Sean Everton, *Disrupting Dark Networks*, 400). Due to their disconnected nature, highly fragmented networks are structurally disadvantaged in terms of communication, coordination, and efficiency.

2. Mobilization and Embedding Processes

During the lifespan of the network, Noordin Top and his organization were directly responsible for a total of four high profile bombing attacks targeting the Marriott Hotel in August 2003, the Australian Embassy in July 2004, the second Bali bombings October 2005 (hereafter also referred to Bali II), and the Jakarta Hotel bombings in July 2009. In addition, Noordin also provided resources and inspirational guidance to at least one other small terror group dubbed the “Palembang Group” based on their location in Palembang South Sumatra.¹⁵⁵ As the network evolved, so did its support base. Between 2003 and 2009 Noordin’s operational cells shifted from relying almost exclusively on school ties to drawing increasing from friendship and later kinship networks for support.

a. Mobilizing Existing Connections

The Marriot Hotel bombing was the first large scale operation conducted by Noordin’s fledgling organization and relied heavily on Noordin’s existing associational networks. All of the attack’s participants were JI members, and JI contacts and provided generalized logistic support. Al Mumkin alumni played important roles in planning, coordination, and transportation of the explosives.¹⁵⁶ All but one of the participants in the Marriot Bombing were members of Noordin’s schoolmates network with the exception of Azhari the bomb maker, who had multiple connections within Noordin’s friendship network.

Noordin’s second attack suggests an effort to expand recruiting outside of the network of JI and school alumni. Conspirators in the September 2004 Australian Embassy Bombing included not only members of JI’s East Division, but also DI and its Banten-based splinter group. Suicide bombers were recruited from among the ranks of DI and the Banten group. Only 75 percent (15 of 20) of the individuals involved as conspirators in the Embassy attacks were linked through Noordin’s networks of

¹⁵⁵ International Crisis Group, “Indonesia: Radicalization of the “Palembang Group” *International Crisis Group, Asia Report*, no. 92 (May 2009).

¹⁵⁶ Roberts, Nancy, Sean F. Everton, and Daniel Cunningham. “The Noordin Top Network,” [Machine-readable data file]

schoolmates.¹⁵⁷ Those who were not linked by school were connected via overlapping friendship and kinship relationships. By the time of Bali II in 2005 friendship relationships dominated, nearly 90 percent of those involved were part of the friendship network in contrast to only 22 percent who shared school ties and just over 10 percent who had kinship ties to the network.¹⁵⁸

The final act of terror conducted by Noordin's network was the Jakarta Hotel bombing in July 2009. Coordination for this attack marked a third shift in the participation paradigm. In the lead up to this attack the majority of participants were linked through Kinship ties (57 percent), while just over a third (36 percent) were members of the friendship network and fewer still were schoolmates (14 percent).¹⁵⁹ It is possible that this final shift may have been spurred by the increased security forces presence, which followed Bali II in 2005 and the arrests of bomb maker Jabir in April 2006 and Noordin's associate and JI leader Abu Dujana in June 2007. Noordin Top was eventually killed in August 2009 in a raid that closely followed the Jakarta bombing, which led to the rapid disintegration of his organization.

Meta-network membership differed considerably across the four high profile attacks attributed to Noordin Top's group. With each attack, membership shifted away from the original school network and relied increasingly on affective ties and kinship. Some of these changes may be attributed to membership losses inflicted by Indonesian security forces or to waning support from the core JI movement who disapproved of Noordin's attacks. However neither of these explanations alone are sufficient to fully account for the changes. Noordin's school network consisted of hundreds of members that could have been drawn upon to replace any losses due to arrests, and JI members accounted for a larger percentage of participants in the final attack than they did during the second attack before JI had distanced itself from Noordin. This suggests that other factors may have played a role in the differential recruitment observed between attacks.

¹⁵⁷ Ibid.

¹⁵⁸ Ibid.

¹⁵⁹ Ibid.

Whatever the explanation for the shift in Noordin's recruitment base, the end effect was that participants were increasingly drawn from decentralized networks. These networks in turn were increasingly connected to bright and shady nodes as depicted in Table 7. One explanation for this is the cumulative effect of arrests and increases in Indonesian security posture that occurred across the span of attacks. This increased pressure may have prompted individuals to turn to networks with higher presumed levels of trust or those that required less conspicuous communication (i.e., family and friends). The speed at which the Noordin network dissolved following Noordin's death composite cliques from which he recruited lacked the will or self-organizing capacity necessary to continue in his absence. These outcomes point to the conclusion that in the case of the Noordin network, embedded ties increased indicators for resilience (decentralization), while simultaneously reducing measure of efficiency.

Table 7. Meta-Network Node and Link Distribution as Percentage of Total Network

Meta-Network Source Summary			
	All Nodes	Bright/Shady Nodes	Total Relationships
Kinship	34	40	15
School	23	20	34
Friendship	41	31	27
Religious	11	10	2

Values Represented as Percentage of Total Network and Bright/Shady network partition. Due to overlapping network membership and exclusion of operational ties values do not sum to 100.

b. Embedded Bright Network Connections

Embedded linkages may be primary factors contributing to rapid mobilization and sustaining operations. Recruitment into Noordin's dark network occurred through face-to-face activation of preexisting associational ties. However, these ties would likely not have been as extensive had they not been formed through bright organizations. Both the Lukmanul Hakim and Al Mumkin pesantrens operated publicly and required relatively limited commitment and risk.

Within the Noordin Top network, religious leaders occupy key positions lending legitimacy to facilitating embeddedness. The International Crisis Group (ICG) describes youth radicalization as occurring through religious study groups and through the recruitment of individuals who had previously been radicalized through “exposure to jihadi preachers.”¹⁶⁰ Noordin directly and indirectly leverage social symbols of legitimacy to facilitate their embeddedness, such as holding meetings at universities, religious schools and even local kindergarten classrooms.¹⁶¹

The mobilization process used by the Noordin Top network demonstrates the value both of both vertical and crosscutting ties. Initial mobilization was facilitated by preexisting JI connections. JI links also provided initial activity with the benefit of ties from sympathetic Muslim schools and organizations. As time went on the Noordin Network grew in size recruiting support from other extremist organizations as well as from sympathetic members of the surrounding community.

C. PROVISIONAL IRISH REPUBLICAN ARMY

This section investigates the impact social embeddedness may have played on the effectiveness of the PIRA from its inception in 1969 to its culminating cease-fire agreement in 1998. The PIRA dataset provides an empirical case/example that is geographically, culturally, and ideologically distinct from the two previous networks examined in this thesis. As with preceding sections, this section’s analysis is divided into three parts, each emphasizing embeddedness and its effect on organizational efficiency and behavior.¹⁶² Analysis will focus on three noteworthy periods within PIRA’s thirty-year active span that represent key moments in PIRA’s evolution: (1) The movement’s

¹⁶⁰ International Crisis Group, “Indonesia: Noordin Top’s Support Base,” *International Crisis Group Asia Briefing*, no. 95 (August 2009): 1.

¹⁶¹ Ibid., 5.

¹⁶² The parts within this section include historical background on the PIRA organization, SNA, and SMT.

genesis (1969–1976), (2) the movement’s apex (1981–1989), and (3) the movement’s culmination (1990–1998).¹⁶³

1. PIRA as a Social Movement: Grievances Ties and Organization

PIRA began as a social movement. It grew out of grievances stemming from perceived and real discrimination toward Northern Ireland’s Irish Catholic population. PIRA’s members were able to use established church organizational ties, in particular family and friendship ties, as a built in social network. Scholars have theorized that, “people engage in collective action because they share certain norms and values related to a specific area of political contention.”¹⁶⁴ The norms and values that existed within the social network of Irish Catholic churches allowed for the free socialization of shared frustrations with the implications of British rule. Catholic neighborhoods, where unemployment averaged 40% or higher during much of the 30 years covered in this study, also helped to foster membership.¹⁶⁵ In the early stages of the movement, this socialization function facilitated initial participation and identification without the risk/commitment of total participation in collective action through civil disobedience or other activities.

The decision to participate in collective action is often influenced by the activities of other members of the social network.¹⁶⁶ Embeddedness in a social network, whether formal or informal, may help to foster identification with a cause and ease the decision to participate. Passy proposes that individuals who identify with a movement and are strongly socialized within the network tend to be more intensely involved with the movement’s activities.¹⁶⁷ It was because of this that PIRA transitioned from

¹⁶³ For ease of discussion within this chapter, some periods from Chapter V have been consolidated. Period 1 in this chapter corresponds to Chapter V periods 1–2, Period 2 Corresponds to Chapter V periods 4–5 and period 3 corresponds to Chapter V period 6.

¹⁶⁴ Florence Passy, “Social Networks Matter. But how?,” in *Social Movements and Networks: Relational Approaches to Collective Action (Comparative Politics)*, ed. Mario Diani and Doug McAdam (Oxford and New York, Oxford University Press, 2003) 23.

¹⁶⁵ John W. Soule, “Problems in Applying Counterterrorism to Prevent Terrorism: Two Decades of Violence in Northern Ireland Reconsidered,” *Terrorism* Vol. 12, (1989), 35.

¹⁶⁶ Florence Passy, “Social Networks Matter. But how?,” 25.

¹⁶⁷ *Ibid.*, 30.

conversations among like-minded individuals into a social movement. Relational data collected by Gill et al. also point to the importance of embedded affective ties in mobilization.¹⁶⁸ They found that core PIRA network members had strong familial and friendship ties to others within the organization.¹⁶⁹ “Entire families rather than individuals become involved in the rebellion, and the propensity for violence seems to be a subcultural trait which is transmitted from generation to generation in the same manner as other cultural traits.”¹⁷⁰ Relationship type may also affect levels of participation. According to Passy, “When recruiters are close friends (as opposed to acquaintances), potential participants tend to trust them and to be convinced that a particular organization is the one most appropriate for conversion of their political interests into a strong degree of commitment.”¹⁷¹ Embedded ties within the PIRA network may have provided the trust necessary for higher levels of participation. Passy also writes that the more an individual (recruiter) is involved with the movement the more likely it is for new members to be convinced to join and participate fully.¹⁷² This effect is even more pronounced, as it pertains to mobilization of members to act, if the members are centrally organized geographically, which was also the case with PIRA organization.¹⁷³ Gill et al. also found that most brigades usually grew and maintained ties within the same brigade, with some variation throughout the organization as a whole. They also discovered that actors that conducted violent operations had the tendency to connect with other violent actors.¹⁷⁴

168 Gill, Paul; Lee, Jeongyoon; Rethemeyer, Karl R.; Horgan, John; Asal, Victor, “Lethal Connections: The Determinants of Network Connections in the Provisional Irish Republican Army, 1970–1998.”

169 Ibid., 60.

170 John W. Soule, “Problems in Applying Counterterrorism to Prevent Terrorism: Two Decades of Violence in Northern Ireland Reconsidered,” 37.

171 Florence Passy, “Social Networks Matter. But how?,” 33.

172 Florence Passy, “Social Networks Matter. But how?,” 33.

173 Ibid.

174 Gill, Paul; Lee, Jeongyoon; Rethemeyer, Karl R.; Horgan, John; Asal, Victor, “Lethal Connections: The Determinants of Network Connections in the Provisional Irish Republican Army, 1970–1998,” 52.

a. Movement Genesis: Period 1 (1969–1976)

The early years of PIRA consisted of primarily of structural changes in the organization itself. During this period of development and initial growth, the movement consolidated from a loosely grouped collection of splinter cells into a more military like structure with companies, battalions, and brigades.¹⁷⁵ The structural changes that took place during PIRA's early years contributed to a relative increase in organizational centralization when compared to its informal beginnings. A centralized command and control structure likely increased efficiency allowing for successful coordinated and attacks like "Bloody Friday."¹⁷⁶ These same brigades/battalions are also given geographic areas of responsibility, which allowed for better command and control as well.

b. Movement Apex: Period 2 (1981–1989)

The structural change that began in the first period continued through to the second (1981). This time period emphasized secrecy and discipline by utilizing a cell structure: "Each cell, in theory, has three or four members known to each other by a pseudonym and directed by an anonymous controller."¹⁷⁷ It was during the transition from the first period to the second period that the political arm of PIRA became active. Sinn Féin began its slow campaign for equal rights for Irish Catholics.¹⁷⁸ Gill et al. describe the period between 1981 and 1989 as marked by an increase in political activity from Sinn Féin on the behalf of PIRA supporters. One of the tactics that proved effective was non-violent hunger strikes. These tactics generated more public sympathy and support for the movement from the surrounding milieu. The tactics were also credited

¹⁷⁵ The brigades are named for the six Northern Irish counties that were excluded from the 1921 Free Irish State treaty and included Armagh, Antrim, Derry, Down, Fermanagh, and Tyrone. Paul Gill & John Horgan (2013) Who Were the Volunteers? The Shifting Sociological and Operational Profile of 1240 Provisional Irish Republican Army Members, *Terrorism and Political Violence*, 25:3, 435–456.

¹⁷⁶ Gill, Paul; Lee, Jeongyoon; Rethemeyer, Karl R.; Horgan, John; Asal, Victor, "Lethal Connections: The Determinants of Network Connections in the Provisional Irish Republican Army, 1970–1998," 55.

¹⁷⁷ John W. Soule, "Problems in Applying Counterterrorism to Prevent Terrorism: Two Decades of Violence in Northern Ireland Reconsidered," 35.

¹⁷⁸ Kathryn Gregory, Provisional Irish Republican Army (IRA) (aka, PIRA, "the provos," Óglaigh na hÉireann) (UK separatists), *Council on Foreign Relations*, Mar 16, 2010.

with having had a positive effect on the election of Sinn Féin (PIRA) members into local political positions.¹⁷⁹ This period had the highest levels of PIRA membership of any other time during the movement. It is arguable that Sinn Féin's legitimizing influence and non-violent tactics may have contributed both to mutual increase in both embeddedness and centralization observed during this time.

c. Movement Culmination: Period 3 (1990–1998)

Period three marks the beginning of the end of violence in the region although it would take more than eight years of negotiations to yield any lasting results. Those results became evident with a cease-fire agreement in 1997 and finally a peace accord in April of 1998. The political arm was largely responsible for the positive outcome that represents the culmination of the movement during this final period. It was through the shared social wrongs that generated sympathy for the movement, along with focused targeting of catholic members of the community that helped maintain recruitment and generate a deep seeded hatred for the authorities. One out of every four Catholics had been arrested since 1970, and the number was higher in the blue-collar communities. Like other dark networks, prisons were an ideal place to recruit; Sinn Féin even organized daily bus trips to the prisons, free to the communities that helped gain even more sympathy.¹⁸⁰ Incarcerations served as a common experience among Irish Catholics and acted as an additional associational network to mobilize popular support. It was in this way the PIRA prison networks mirrored those observed in the Southeast Asian FFF and the Noordin Top case studies.

2. Longitudinal Social Network Analysis

This subsection analyzes PIRA from the perspective of bright and dark players. Agents within the dataset are broken into groups based on their activities within the

¹⁷⁹ Ibid.

¹⁸⁰ John W. Soule, "Problems in Applying Counterterrorism to Prevent Terrorism: Two Decades of Violence in Northern Ireland Reconsidered," 36.

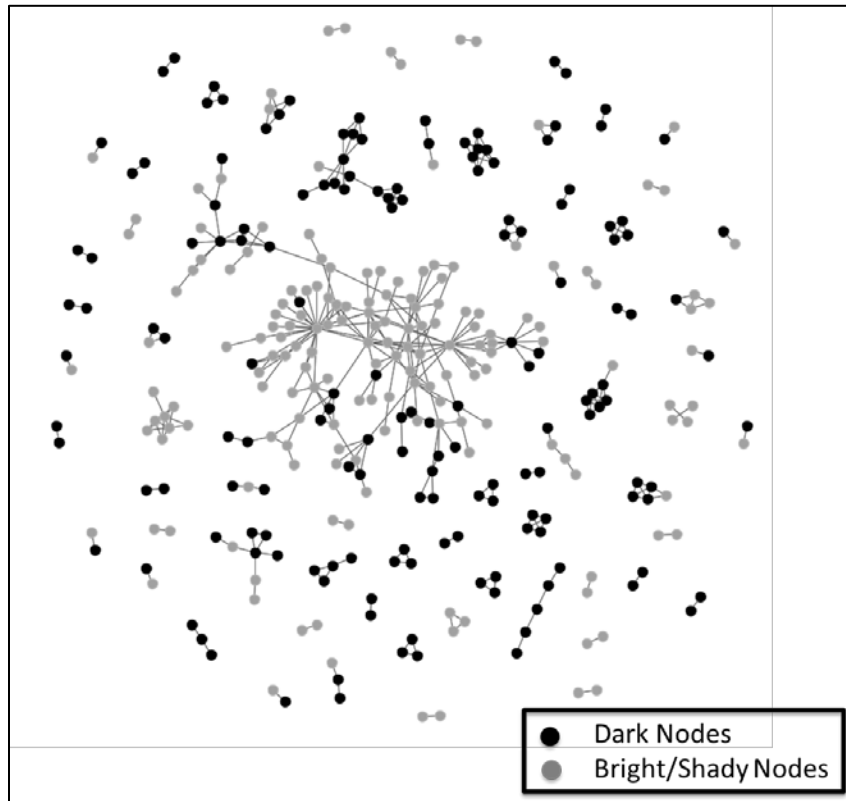
network.¹⁸¹ The following sociograms provide visualizations of how the network changed over the course of the movement. The snapshots are derived from data from periods one, two, and three. As Figure 25 indicates, from 1969-1976 PIRA was a network of multiple cores and cells working loosely together. Visual analysis quickly reveals that the distribution of dark and bright nodes within the PIRA network differs considerably from the previous networks. Namely, over 50% of its senior leadership are non-violent (bright), and were therefore not pursued or targeted due to lacking operational ties. The bright partition of the network appears considerably both more central and more centralized than the total overall.

Visual analysis also reveals a considerable degree of homophily or the tendency to connect with individuals who are characteristically similar between actor categories (dark and bright). According to Gill et al., this tendency may have played a part in explaining who connected and interacted with whom. Homophily, which is a common trait among social networks, would have allowed for more operational security (OPSEC) specifically in the more illicit activities like IED construction and kidnapping.¹⁸²

181 Dark networkmembers are any of those who participated in violent or illicit activities such as robbery, kidnapping, improvised explosive device (IED) construction, bombings, or shootings/assassinations. Bright members are individuals who have not been associated with any of the aforementioned violent activities. This dichotomy is first illustrated in Figure 25.

182 Paul Gill; Jeongyoon Lee,; Karl Rethemeyer, R.; John Horgan; Asal, Victor, "Lethal Connections: The Determinants of Network Connections in the Provisional Irish Republican Army, 1970–1998," 54.

Figure 25. PIRA Network Period 1 (1969–1976)



334 Nodes (161 bright/shady) and 810 links (isolates removed)

As time passed, the movement grew and underwent a series of structural changes. Figure 26 depicts period two (1981-1989). During this period, PIRA enjoyed its highest level of membership. The network was also more centralized than the previous timeframe as a “small core group of leaders”¹⁸³ emerged to coordinate and link brigades. As in the previous period, membership was nearly equally split between bright and dark members. In this period, dark members are more centrally located within the network. In spite of this, the homophily observed previously in period one persists, with bright members predominantly linked to other bright members and with a few dark members serving as links to other dark nodes within the network.

¹⁸³ Ibid., 68.

Figure 26. PIRA Network Period 2 (1981–1989)

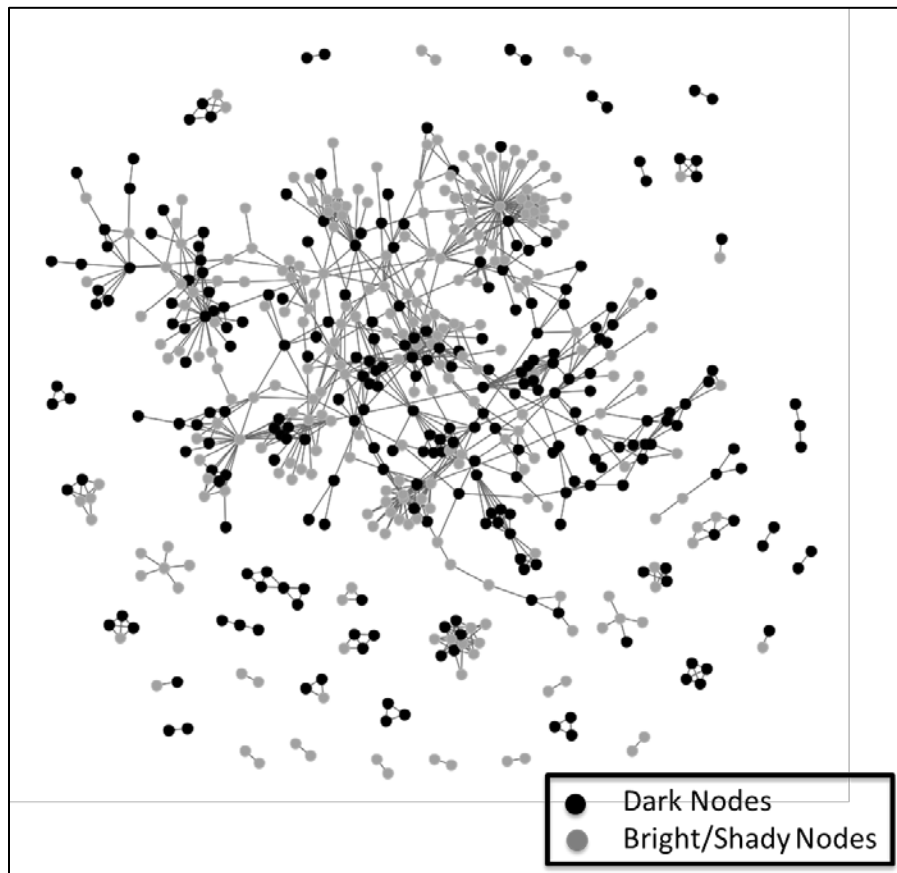
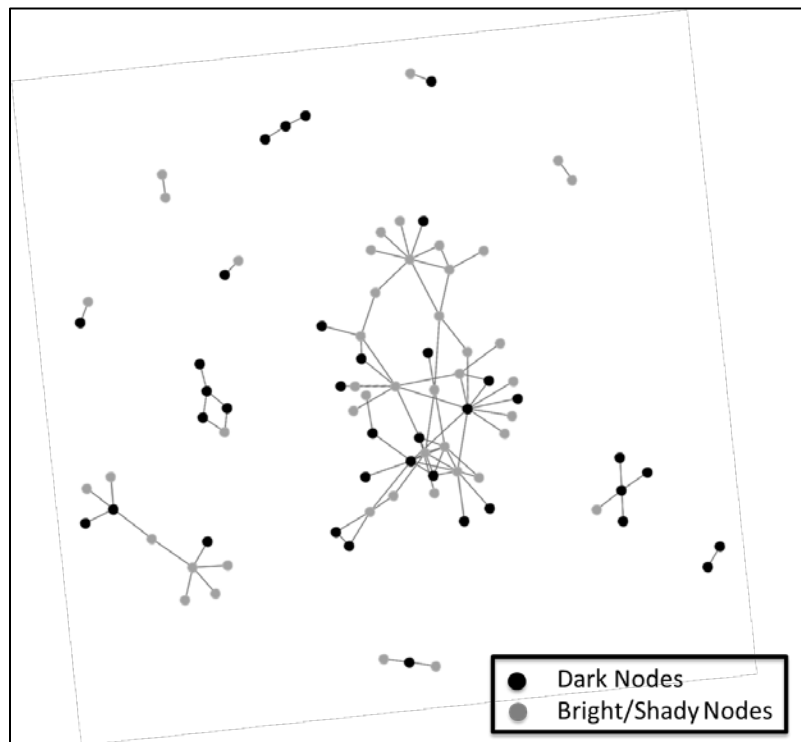


Figure 27 depicts the network as it existed between 1990 and 1998. During this final period, membership was concentrated within a central cluster. In this period the percentage of dark nodes increased to replace bright entities as the majority percentage of membership. In spite of this increase, dark nodes in period three were less centrally located and less connected than they were during period two. The majority of dark nodes in this period are linked to the network through connections with bright entities.

In period three the movement began a trend of decreasing membership. This trend, coupled with a shift in focus towards the political arena, may have led to the decrease in the number of attacks conducted during this time. In this case, the shift away from violence may actually be reflective of Sinn Féin's success; according to Audrey Cronin, "sometimes terrorist attacks are seen as an effort to nudge the flow of history further in one's direction. If history is moving along the right way (and at the right pace),

then the incentives for violent behavior decrease.”¹⁸⁴ In the case of PIRA, the attacks of the early 1990s may have provided the “nudge.” Cronin’s theory may help to explain why in the early 1990’s violent attacks increased, even as negotiations gained traction. By the latter half of the 1990’s, as political goals were met the incentive for violence went away, resulting in a sharp decline in attacks observed in the final period, as depicted in Figure 12 in Chapter V.

Figure 27. PIRA Network Period 3 (1990–1998)



83 nodes (46 bright/shady) 184 links (isolates removed)

Figure 28 depicts the brigade affiliation for all three periods observed. The figure helps demonstrate the ties within brigades as well as their connection to the rest of the movement. They also help to reveal how the changes in organizational structure were represented within the brigades. Data supports the fact that the Antrim brigade had the majority of the senior leadership w/in the movement, but individuals without brigade

¹⁸⁴ Audrey Kunth Cronin, *How Terrorism Ends: Understanding The Decline and Demise of Terrorist Campaigns* (Princeton and Oxford, Princeton University Press, 2009), 105.

affiliation maintained high levels of activity and responsibility within the network. Fifty percent of senior leaders within non-violent groups were not affiliated with any brigade. This result was unexpected. It is plausible that the percentage of unaffiliated leadership was driven by external factors within the environment. Specifically, in order to protect those leaders from being targeted by law enforcement. These non-affiliated (bright) leaders avoided official membership while maintaining central roles within the organization. Figure 28 provides a visualization of brigade affiliation within the network for all three periods.

Figure 28. PIRA Network Brigade Affiliation

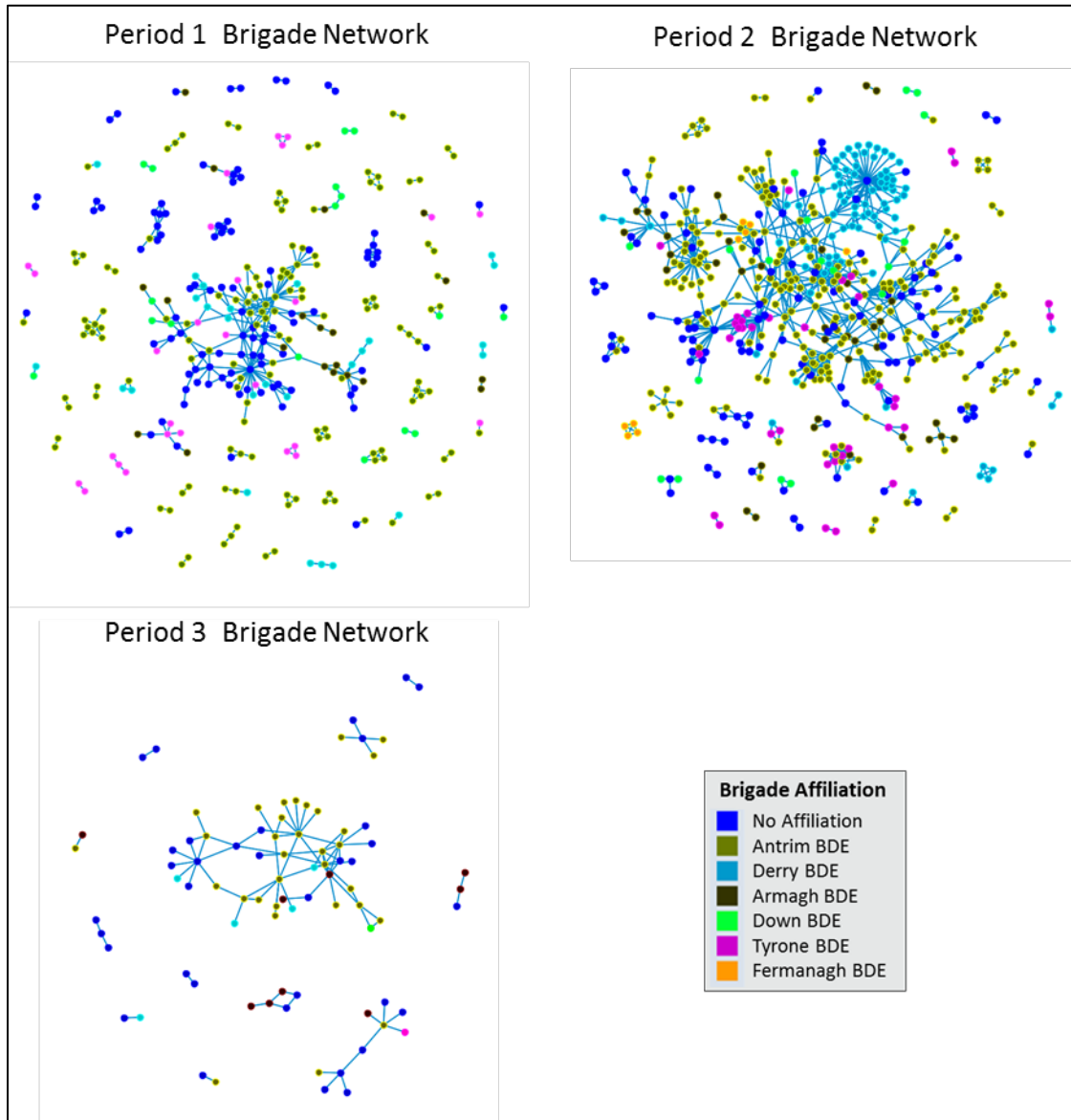


Table 8 presents the basic topographical measures of the PIRA network for all three time periods. Centralization and violence do not appear to be correlated, based on the data presented in the table. With the resolution of the violence occurring during this period one might expect the statistics to be reversed, with more bright members and less dark actors. Almost 2/3 of the actors in the last period were dark network members. In period 1 there were almost twice as many attacks as there were members, but during the second period when the movement was the largest, the number of attacks was higher per

year, but not as it related to membership, and by the last period the number of attacks were half that of membership. Centralization scores increase consistently through the lifecycle of the network.

Although family ties are constant during all three periods, the other ties that are attached to the network may have affected the higher centralization scores. Based on observations of the Noordin Top network discussed earlier in this chapter, analysis determined that embeddedness through family ties tends to introduce network subsets, which are more cosmopolitan and decentralized in nature. PIRA history suggests that while family ties provided a backbone for the network, through the course of its existence and as time progressed, places of socialization such as churches, public houses and shared incarceration experiences (prison) gave access to sub-networks that are more prone to centralization, provincialization, and cross-cutting ties. The reliance on drinking clubs by the social movement as a major source of finance is one indicator of their importance. These may provide cross sectional linkages or interconnectivity that the kinship ties do not, resulting in the increased centralization within the network as it progresses through its history as depicted in Table 8.

Table 8. PIRA Network Topographical Measures

PIRA DATA RESULTS				
Catagories	Period 1	Period 2	Period 3	
SIZE (Number of Nodes)	334	526	83	
NUMBER OF LINKS	810	2050	184	
AVG DEGREE CENTRALITY	4.1	3.9	2.2	
DEGREE CENTRALIZATION	0.071	0.086	0.097	
DENSITY-CLUSTERING COEFFICIENT	0.339	0.462	0.121	
BETWENNESS CENTRALIZATION	0.056	0.16	0.11	
EIGENVECTOR CENTRALIZATION	0.208	0.449	0.264	
PERCENTAGE BRIGHT	52	51	37	
TOTAL NUMBER OF ATTACKS PER YEAR BY PERIOD PERIOD	75.5 X 8	91.78 X 9	10.75 X 4	
TOTAL NUMBER OF ATTACKS	604	826	43	

Throughout the movement British authorities treated PIRA sympathizers, members, and Catholics in general, differently than other citizens of Ireland. Although 86% of the Catholics did not support violence as a means to produce political change, British tactics such as 4am home searches, stop and frisk, internment, special interrogation techniques, and convictions based on one witness, only served to foster hatred for the authorities and more sympathy for the movement.¹⁸⁵ The fact is that because of the close-knit communities, everyone encountered PIRA in some way, even if they were not members. According to John Soule, PIRA was often used as a neighborhood police force to settle disputes and punish crimes within the Catholic community; drinking clubs were often owned and operated by PIRA sympathizers or financiers; and PIRA financially supported the families of jailed Catholics.¹⁸⁶ With authorities alienating the populace and PIRA generating sympathy for its cause, it is no wonder the movement lasted for 30 years.

The preceding sections have explored the differential effects of embeddedness on network structure and behavior. As was observed in chapter IV, the outcomes of embeddedness do not appear to be structurally determinate. Analysis within this chapter suggests that embeddedness may be an early contributor to organizational growth, and that some of the structural effects observed in Chapter V may be associated with dark networks mirroring the structure of constituent parts. The following chapter will discuss the implications of these findings as well as those of Chapter V.

185 John W. Soule, "Problems in Applying Counterterrorism to Prevent Terrorism: Two Decades of Violence in Northern Ireland Reconsidered," 31–32.

186 Ibid., 38–40.

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VII. INFERENCES FROM THE STUDY OF DARK NETWORK EMBEDDEDNESS

This chapter synthesizes the findings of the two previous analytic chapters and offers insights and recommendations based on noteworthy research observations. This chapter is divided in to four sections encompassing general findings, methodological implications, areas for future research, and operational applications.

A. GENERAL FINDINGS

This thesis sought to answer the question the question, what is the nature of the relationship between social embeddedness, organizational behavior, and structural efficiency within dark networks? Overall, the analysis does not appear to confirm the initial hypothesis that embeddedness is positively correlated with structural efficiency within dark networks. This thesis used group E-I index as a measurement of embeddedness and centralization and density as a factor of efficiency.¹⁸⁷ In examining the linkages between dark networks and society this thesis found no consistent relationship between social embeddedness and structural efficiency within contested covert organizations. Its findings were also inconclusive in terms of embeddedness's effect on organizational behavior or activities, though embedded relationships do appear to impact recruitment and mobilization.

In regards to comparing qualitative and quantitative methods, this thesis observed that combined, the approaches used provide superior diagnostic capability than either approach used alone. In one example, combining measurements of deviations in topographic measures between real and simulated network observations over time with contextual clues, contributed to understanding observed E-I index variations by linking spikes in embeddedness to periods immediately following actions by security forces. In another example meta-network analysis provided a potential explanation for the observed negative correlation between E-I index and centralization. Simulation results also helped

¹⁸⁷ Due to variations in network size, average degree centrality is used as a proxy measurement for density for the majority of this thesis.

distinguish endogenous network dynamics from exogenous shocks that affect network evolution.

After comparing the results and efficacy of the individual analytic methods used, this thesis found that qualitative and quantitative approaches produced varied, though, complimentary results. The statistical approach tended to be more effective in identifying the differential relationship between embeddedness and structural efficiency but less effective in explaining it. This limitation was amplified in instances where inter-case study results differed. In contrast, qualitative social movement theory (SMT), and social network analysis (SNA) consistently provided nuanced descriptions and explanations for changes in organizational structure and behavior although they were highly reliant on statistical means in terms of quantifying those changes and their effects.

B. ENABLING EFFECTS OF EMBEDDEDNESS

Embeddedness does not appear to be unconditionally related to structure or behavior; however, the analysis did reveal a number of areas where embedded ties appear to contribute towards operational rather than structural efficiency: initial mobilization, and finance. Across all three cases embedded linkages formed through preexisting associational networks or kinship groups and played important roles in early recruitment and mobilization. Ties to shady organizations and prison networks served in a similar capacity. In the case of the Southeast Asian Foreign Fighter Facilitation (FFF) network and the Provisional Irish Republican Army (PIRA), embedded linkages played an ongoing role in contributing to finance and movement growth. Financial support from bright ties varied across datasets and included religious charities, humanitarian organizations, and public donations.¹⁸⁸ Although these associational networks and organizations sometimes fell under the management of “dark” members, there are multiple examples such as NORaid in which bright financiers operated autonomously from their supported networks.¹⁸⁹

¹⁸⁸ John W. Soule, “Problems in applying counterterrorism to prevent terrorism: Two decades of violence in Northern Ireland reconsidered,” 38, 39.

¹⁸⁹ Ibid.

In addition to the broad contributions towards operational efficiency discussed previously, links to bright entities also appear to have contributed towards the operational efficiency of dark networks by allowing them the ability to conduct business through the convenience of public channels. In other instances, these connections appear to have contributed to security in the way of members providing shelter to fugitives or performing low risk tasks; however, available data was insufficient to allow for a conclusive determination on the magnitude and consistency of these contributions.

C. QUANTITATIVE METHODS

This thesis combined correlational analysis and permutation testing in an attempt to validate existing social network paradigms. Many of the conceptual theories used in SNA have not been tested beyond the theoretical level. Although the methodology utilized in this study did not support the initial hypothesis, it allowed for the rigorous testing of a relationship that has not been fully examined from a practitioner's perspective. Output measures from the permuted networks illustrate that empirically observed relationships vary from those of permuted networks. This suggests that sociological or environmental factors likely do play a role in shaping network structure.

Contextual analysis suggests that exogenous factors such as the security environment or intra-network conflict introduce a number of variables that significantly limit objective evaluation of the relationship between structure and dark network performance. Without the simulation results, this observation would not be substantiated. It also suggests that structural efficiency may be both situationally dependent and sensitive to external forces. For example, actions conducted by security forces may introduce countervailing influences on network efficacy when members of an organization are arrested or have positive effects on efficiency when their actions alienate said forces from the population as was observed in the case of the PIRA. These factors impact the ability to normalize a movement to a degree in which predictive analysis is practicable.

D. AREAS OF FUTURE RESEARCH

This thesis has illuminated several interesting similarities among all three case studies and in doing so revealed two areas in which further research may be warranted. Those areas are the roles of associational prison networks in dark network operations and the varying effects of embedded ties.

1. Prison Networks

As described previously, associational networks appear to provide a framework which dark networks can exploit for recruitment and to mobilize support. Findings from Chapter VI suggest that prison networks may play a role in insurgent mobilization. All three networks used prison networks to support organizational objectives. According to the International Crisis Group, prisons provide forums for intergroup association and recruitment.”¹⁹⁰ The Southeast Asian FFF, as well as the Noordin network, used state controlled prisons to recruit, to translate and produce literature, and even create new organizations through radicalization among unaffiliated inmates. ICG reports have gone so far as to describe scenarios where, visitation has been allowed between inmates and violent extremist affiliated individuals, some even while authorities were actively seeking them. This was a common occurrence, and came up many times during our analysis. The FFF network also used religious education as a pretense for meeting with other followers within the prisons. Local imams were often brought in to provide religious instruction that bordered on incitement to radicalization, all while inside the walls of these facilities.¹⁹¹

The Irish prison network contributed to mobilization somewhat differently than the Southeast Asian Network. For PIRA, prisons served not only as a forum for recruitment, but also as a means to mobilize broader support. Sinn Féin, PIRA’s political arm, used the appearance of unjust incarceration to garner public sympathy. By bussing in the families of the interned and jailed, PIRA was able to generate propaganda and proliferate hatred toward their British oppressors. In this way, family members of

¹⁹⁰ “Indonesia: How Indonesian Extremists Regroup,” *ICG Asia Report*, no. 228 (July 2012), 1.

¹⁹¹ *Ibid.*, 15.

detained individuals might also be motivated to join the movement. Additionally, due to British detention standards, many arrests did not require proof of a crime. Incarceration served as a galvanizing experience shared both by members of the movement and the Irish Catholic community at large. Among PIRA's members, imprisonment became a badge of pride.¹⁹²

In light of the extensive evidence linking associational prison networks with dark networks operations, this thesis recommends further research into the dark network prison network nexus. Future research in this vein may aid in illuminating associational networks, which governments are in a unique position to monitor, disrupt, or influence.

2. Varying Effects of Embedded Ties

Quantitative analysis demonstrated that in some cases increased embeddedness may have a negative effect on structural measures of efficiency. Factors revealed during the course of analysis provide three possible explanations for these seemingly unexpected results that may warrant future inquiry. The first hypothesis is that, to the degree a dark network is embedded within a particular component of society, the structure of the dark network will begin to mirror aspects of said component. In short, the negative correlation observed may reflect endogenous structural characteristics of the bright supporting network. In the example provided by Noordin case, the kinship network was markedly more decentralized than the associational friendship or schoolmates networks, and over time it was increasingly drawn upon as a source of membership, thus reducing the net centralization of the larger group. A second hypothesis is that the extreme levels of contestedness faced by each of the dark networks limited the organizations from capitalizing on embedded security gains by way of improving structural efficiency. A third possibility is that existing theoretical assumptions about the roles that network centralization and density may overstate the importance of structure in determining organization performance. Much of the SNA research in security studies to date the topic of structure and performance has been theoretical and has not rigorously tested for causal

¹⁹² John W. Soule, Problems in applying counterterrorism to prevent terrorism: Two decades of violence in Northern Ireland reconsidered, *Terrorism*, Volume 12:1, Taylor and Francis, UK, 1989, 39.

linkages between the two variables nor has it normalized for the effect of endogenous and exogenous factors.

E. OPERATIONAL AND POLICY APPLICATIONS

This thesis notes that the most observable effects of embeddedness on dark network performance were in the areas of mobilization and recruitment. In light of this observation this thesis recommends that intelligence and security professionals faced with the prospect of combatting an emergent dark organizations, look to identifying and monitoring relevant preexisting associational bright networks. Developing a working understanding of where dark networks emerge from can aid in stemming the growth of said networks and contribute to the development of strategies to disrupt dark network operations. This could have significant implications on fighting the foreign fighter networks active in South East Asia. Instead of focusing only on fighters themselves, network illumination should also shed light on bright facilitator nodes and ties.

This thesis also observes that embedded associational linkages contribute most directly to mobilization and recruitment early on, and that over time connections based on public forms of interaction may be surpassed by relationships that may be more difficult to observe or influence, such as friendship or kinship networks. It follows, that the most effective moment to intervene against preexisting networks is early on. Failure to do so in a network's formative period may result in lost opportunities later on.

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